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Advances in Information Communication Technology and Computing

Proceedings of AICTC 2022

Springer

Lecture Notes in Networks and Systems

Volume 628

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Preface

This Conference Proceedings volume contains the written versions of research contributions accepted and presented during the 4th International Conference on Advances in Information Communication Technology and Computing (AICTC-2022). Like in previous year, it took place at Government Engineering College Bikaner, Rajasthan, India, during December 17–18, 2022.

The major goal of AICTC-2022 is to give academicians, engineers, and researchers a scholarly venue where they may present their cutting-edge research and innovative work in the broad fields of computing and communication. A wide range of interactive forums, core technical sessions, and top-notch research articles have been presented at the conference. ICT and computing are fields that are constantly concerned with coming up with new ideas, methods, and tools to solve the related issues. In general, innovation refers to creating new methods for carrying out routine tasks or creating entirely new actions. However, since technology evolves at an accelerated rate, wise innovations are required. The system, paradigm, approach, and technical reviews that use knowledge and intelligence across a broad spectrum are covered in the conference proceedings.

AICTC-2022 got over 357 entries from 15 different nations, including the USA, Russia, China, Ghana, the UK, Oman, Kazakhstan, and Uzbekistan. Each submission has been checked for plagiarism and underwent thorough the two-reviewers-based review system. A few entries have even undergone more than two reviews. Totally, fifty-one excellent articles were chosen for publication in this proceedings volume, with an acceptance rate of 14.28%.

We would like to thank all participants for their contributions to the conference program and for their contributions to the proceedings. We also express our sincere gratitude and appreciation for all of the reviewers for their constructive comments on the papers. We would also like to extend our thanks to the members of the organizing team for their hard work.

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Bikaner, India   Manoj Kuri
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Intelligent Quality Guarantor Model for Computer Vision Based Quality Control

Anton Ivaschenko , **Oleg Golovnin** , **Vladimir Avsievich** ,
and Pavel Sitnikov

Abstract The paper studies a problem of production workplace adaptation using the computer vision based analysis of performance and quality control. There is proposed a new "intelligent quality guarantor" based on decomposition of the quality control process to the tasks of deviances identification. The solution is capable of capturing the individual characteristics of production personnel to provide intelligent decision-making support in real time. An artificial neural network is used to provide analysis of the operator's behavior, derive the typical individual actions and classify them using the patterns of efficient and weak performance. The proposed approach improves the user interfaces of production cyber-physical systems for better comfort ability of the computer–human collaborative environment. The example of the proposed concept efficient use in practice is given for an automobile wire production manual operations control, where it is critical to consider the individual experience of production personnel.

Keywords Computer vision · Quality control · Cyber-physical systems · Workplace adaptation · Intelligent quality guarantor

1   Introduction

Computer vision implementing modern artificial neural networks is a promising technology for industrial applications. Among the most useful areas of its utilization in production and manufacturing there are often mentioned automated inspection and robot guidance. Taking into account its benefits and constraints the computer vision module can become a component of an industrial robot with autonomous behavior

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or a part of a computer–human interface helping the operator to perform regular actions.

At the same time in the domain of Industry 4.0, especially in the areas of industrial quality control systems, application of computer vision remains limited. One of the reasons is a low sensitivity and accuracy comparatively to various types of sensors and high dependence on influencing external factors like the quality of lighting, the presence of pollution, the appearance of shadows, etc.

However, computer vision has greater autonomy and versatility compared to other technologies of the Internet of Things. It is a challenging problem to find as appropriate place of this technology application in an industrial enterprise. One of the possible solutions is production workplace adaptation considering the modern requirements and standards of quality control.

2 State of the Art

Quality control organization is one of the key challenges of production enterprise management [1]. In the original setting it assumes testing units and monitoring whether they satisfy the specifications. According to the modern theory of quality management [2], the achievement of specified quality indicators for a product is determined by the quality of the implementation of the production process. One of the basic factors affecting the quality of the production process is the presence of critical deviations from the requirements for its implementation, including compliance with the requirements for the operations performed.

Usually, to assess the quality of production processes, a set of indicators is used that determine generalized characteristics, such as specialization, repeatability, continuity, flow, rhythm, etc. However, the initial data for these characteristics can be reduced to time and correspondence. Respectively the main quality issues are concerned with the delays and failures. From this point of view the role of statistical methods of quality control is high. Statistical methods [3, 4] are used to identify the probability of faults and influencing factors in order to improve a number of quality parameters. Statistical quality control provides immediate identification of the place and time when the quality starts to diverge from the standard. One of the main problems of quality control is to make it robust against to uncertainties, which allows increasing product reliability and safety operations.

Such problems of statistical analysis of complex data as classification and clustering are being successfully solved by artificial neural networks [5, 6]. Rapid development of modern technologies of Computer Vision and Artificial Intelligence [7, 8] provides new opportunities for improving the integrated system of technical control and quality management at a manufacturing enterprise.

At the same time, implementation of computer vision in this area is challenging due to a low standardization of quality parameters and indicators of the artificial intelligence itself, which leads to the intelligent systems reliability and trust issues.

To solve this problem there should be developed new concepts and approaches of intelligent computer vision application for production quality control.

Smart automation and intelligent technologies application in production is declared by a concept of Industry 4.0 [9, 10]. Despite the fact that computer vision is not mentioned in the list of Industry 4.0 core components, it is commonly used as a part of solutions for advanced human–machine interfaces and smart sensors. Indeed, when collecting information required for quality control, Internet-of-Things technologies of higher accuracy and reliability are usually used [11]. However, computer vision takes its own niche.

3 Intelligent Quality Guarantor

Intelligent quality guarantor is a model for computer vision system based on decomposition of the quality control process to the tasks of various deviances identification. It allows combination of several intelligent components targeting various computer vision problem solving.

Let us consider a production process $p_{n,m}$ of the unit u_m which contains a number of operations:

$$p_{n,m} = \left\{ g_{n,m,k}\left(\left\{\Omega_{n,m,k,l}\right\}, \tau_{n,m,k}\right)\right\}, \tag{1}$$

where $\Omega_{n,m,k,l}$ represents a process quality metric, which characterize a corresponding quality parameter of the unit, $\tau_{n,m,k}$—time frame of expected operation fulfillment, which can be set both absolutely and relative to the beginning of the process.

Execution of the process in an operational area of the production sector is characterized by action events of an employee a_i:

$$e_{n,i,j} = e_{n,i,j}\left(u_n, \left\{q_{n,i,j,s}\right\}, t_{n,i,j}\right), \tag{2}$$

where $t_{n,i,j}$ is the moment of the event, $\left\{q_{n,i,j,s}\right\}$—a set of fixed metrics that characterize the action performed.

The main difference of this model from the existing approaches of quality control is that the employee gets certain autonomy. He or she is expected to perform actions correlated to the corresponding process, but their exact sequence, time and scope can differ from the predefined specification. The only fact that can be determined by a machine vision system is that some subject a_i has performed some action on an object u_m with certain metrics $\left\{q_{n,i,j,s}\right\}$.

Production process quality depends from the number of faults and deviations that can be specified using the provided above definitions of the performance indicators. We postulate that quality guarantor is individualized for each employee therefore will consider these indicators individually for each pair (a_i, u_n).

Minimum of faults in the quality metrics satisfaction of the corresponding processes and actions:

$$F(a_i, u_n) = \sum_j \sum_{m,k} \sum_s \sum_l e_{n,i,j} \cdot g_{n,m,k} \cdot (e_{n,i,j}, g_{n,m,k})$$
$$\cdot \delta(q_{n,i,j,s} \notin \Omega_{n,m,k,l}) \to \min, \tag{3}$$

where $(e_{n,i,j}, g_{n,m,k})$ is the Boolean function that represents the correspondence (matching) of the action to the required operation;

$\delta(x)$ is a step function $\delta(x) = \begin{cases} 1, & x = true; \\ 0, & x = false. \end{cases}$

Minimum of deviations between the actions and operations in time:

$$F(a_i, u_n) = \sum_j \sum_{m,k} e_{n,i,j} \cdot g_{n,m,k} \cdot (e_{n,i,j}, g_{n,m,k}) \cdot \delta(t_{n,i,j} \notin \tau_{n,m,k}) \to \min, \tag{4}$$

Minimum of excessive and redundant actions:

$$V(a_i, u_n) = \sum_j e_{n,i,j} \cdot \delta\left(\sum_{m,k} (e_{n,i,j}, g_{n,m,k}) = 0\right) \to \min \tag{5}$$

This model does not consider the employees' specialization and distribution of the operations between the staff, which makes the difference from the production planning and manufacturing execution problems.

The statements (3–5) describe an alternative characteristic of the process quality, which are useful in practice in intelligent computer vision systems for production quality control.

Intelligent quality guarantor is sensitive to critical deviations. It means that the employee can diverge from the specification to some extent, but should satisfy the basic quality parameters of the standard. This approach considers the human factor and provides the required flexibility for a computer vision system.

This approach allows decomposing the problem of computer vision to three tasks:

1. Identification of the delays $t_{n,i,j} \notin \tau_{n,m,k}$;
2. Decision on the correspondence of actions and operations $(e_{n,i,j}, g_{n,m,k})$;
3. Identification of the quality metrics faults $q_{n,i,j,s} \notin \Omega_{n,m,k,l}$.

Identification of the delays is carried out by matching of timestamps of the required timeframes of the process operations and the events that characterize the actions performed. In its turn, solving of the next two tasks require Artificial Intelligence.

Correspondence of actions and required operations is determined by either comparing the patterns of actions and operations or as a result of solutions of a classification problem. In the last case the photo images or videos of the operations performed by a highly qualified employee can be taken as a training dataset sample.

When solving the problem this way there is no need for formalization of the observed character events.

Identification of non-compliance of the quality metrics with specification requirements is mostly determined by the specifics of the problem domain. For this purpose there can be introduced a number of quality testing stands that form a quality control process gates, equipped with specialized sensors. Computer vision in most cases cannot provide the required high resolution of the measured parameters.

At the same time for the processes with known performance and reliable quality assurance intelligent computed vision can successfully determine the risks of quality failure by identification of the deviations of the staff actions from the patterns known as efficient. This deviation can be caused mainly by an influence of human factor.

Therefore the proposed model allows decomposing the problem of quality control to three tasks, which the intelligent computer vision system can effectively deal with. In this case an artificial neural network can be used to provide analysis of the operator's behavior and derive the typical individual actions.

4   Implementation Architecture

The proposed above model was implemented by SEC "Open code" as a platform for manufacturing production enterprises. The solution embodies the idea of building a process quality gate equipped with an intelligent visual monitoring and control system. The quality gate is a control point at which the results of the next stage of development and launching of products are checked and a decision is made to proceed to the next stage. In this case, the quality of production is defined as a set of characteristics of an object related to its ability to meet established and anticipated needs.

Intelligent quality guarantor implementation is a hardware and software complex that provides visual control of product compliance with a given parameter using machine vision components, identification of inconsistencies and defects, collection and processing of information on the current quality of products within a specialized situation center integrated with PDM and ERP systems.

Intelligent quality guarantor implementation architecture is presented in Fig. 1. Quality guarantor can be installed both autonomously, at the control point, and integrated with production equipment, including sorting and coordinate measuring machines. In this case, it is additionally provided for the implementation of an interactive reference manual that provides contextual information to personnel using Augmented Reality. A knowledge base (Ontology) is used to configure and set up quality assurance, which provides semantic search and logical inference based on design and technological documentation about products, as well as operating manuals for the production equipment used.

To identify defects, an artificial neural network (NN) is included in the Intelligent Quality Guarantor. The training of the neural network is carried out as part of production workplaces adaptation of for a specific manufacturing enterprise. At the same

Fig. 1 Intelligent quality guarantor implementation architecture
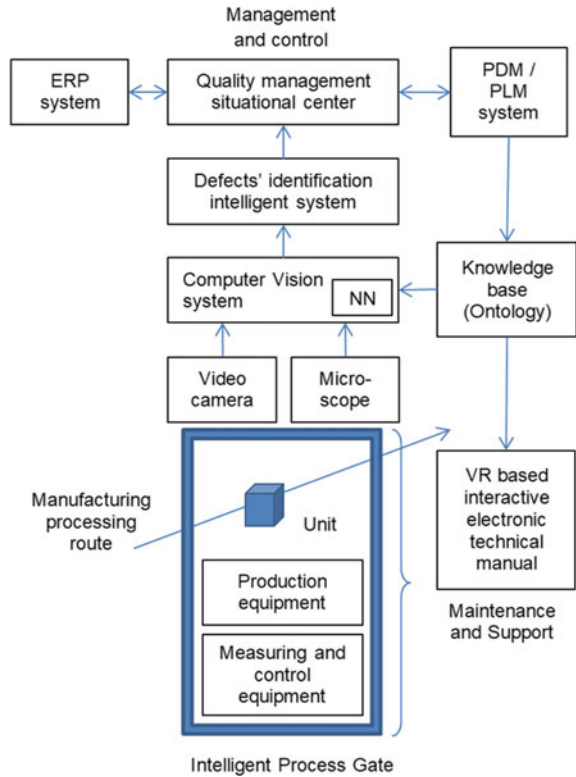
time, it is also possible to use various instrumentation and computer vision system equipment. This tool is highly promising for controlling assembly and packaging operations, monitoring workplaces and monitoring compliance with standards.

Considering the mentioned above strengths and weaknesses of a computer vision implementation for quality assurance, the place of its most effective use is found in production workplace adaptation. It means supplementation the production personnel with additional interactive user interfaces based on sound notifications and Augmented Reality that provide additional information and thus helping them to reduce the errors caused by human factor.

The proposed approach improves the user interfaces of production cyber-physical systems improve the comfort ability of the computer–human collaborative environment.

5 Practical Use Case

An illustrative example of quality guarantee practical use describes the experience of Augmented Reality system development and implementation for labour rehabilitation and adaptation of personnel with vision disability [12]. To solve this problem there was proposed an original hardware and software solution for adaptation of the workplace presented in Fig. 2. The system features include automatic sorting, defect recognition and quality control.

Quality control of products and production processes in turn provides for the implementation of photo and video processing of the results of monitoring e.g. assembly of parts and components, and control of the facts of operations performed. Image recognition for objects and actions identification was implemented using a convolutional neural network (CNN) consisting of one input image, two convolutional and two downsampling (subsampling) layers. The OpenCV computer vision library was used for preliminary image processing. To accelerate the training of the neural network we used a server with GPU.

According to the quality guarantee model there were defined the types of recognized units un: assembly gun, corrugated tube and wire fastening. $(e_{n,i,j}, g_{n,m,k})$ was specified for the event of operator assembling the wire. Hands of the operator performing the assembly were identified separately. This information was used to markup the training dataset. The video showed various stages of the wire assembly from different positions and viewing angles. The resulting training dataset consists of 9437 images including 4000 images of units and 2000 images of actions.

The solution implements the following main functions:
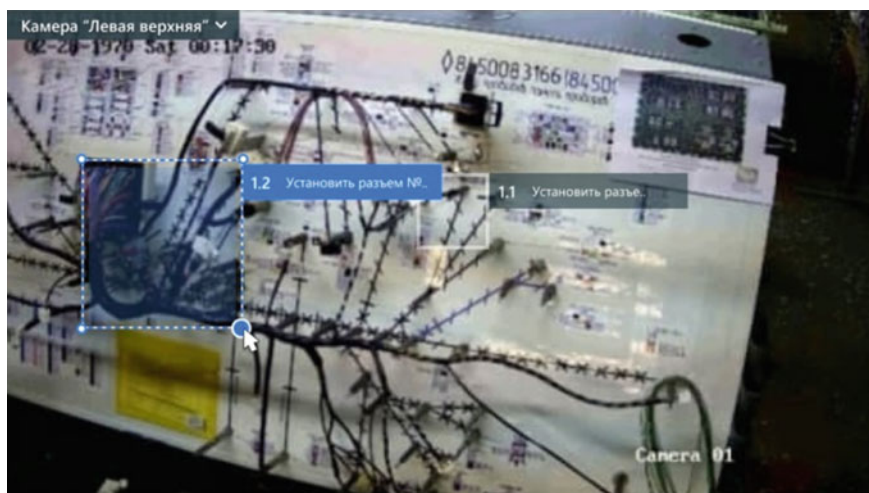
Fig. 2 Production workplace adaptation: screenshot of the AR assisting system that implements manual operations recognition and control

- recognition of the production process of wires assembly and testing based on video filming in real time;
- control of the production process of wires assembly and testing based on video filming in real time;
- informing the contractor about errors made during the assembly/testing of wires;
- saving data about the contractor's mistakes made during the assembly/testing of wires.

In case of erroneous actions of the user at any stage of the process, the system displays an informing window about the error he made with sound notification. The system shows at what stage the user skipped a certain action, thereby controlling the production process. Notifications' appearance is supplemented by corresponding sound alerts.

The recognition process exceeded 95%, which indicates a high rate exceeding the probability of an operator making a mistake, without using a manual control system. As the result additional visual elements are added to the user interface helping the personnel to overcome the problems caused by the lack of visual information and thus provide comfortable adaptation of the workplace.

6   Conclusion

Intelligent quality guarantor model provides a solution of computer vision application for production workplace adaptation considering the features and limitations of its practical use. It allows meeting the specific requirements of workplace personification and extends the comfort ability of the computer–human collaborative environment. Further research allows expanding the proposed approach among the production enterprises to improve the standards of reliability and trust in Artificial Intelligence.

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The Impact of IT Capabilities on Competitive Advantage

Ahmed Tijani, Mohammed Majeed, Asare Charles, and Nana Arko-Cole

Abstract The hospitality industry is an emerging sector globally and requires both attention and technology investment. Hence, the purpose of this study was to look into how IT capabilities affect hotels' ability to compete. The 153 respondents for the survey included managers, members of the kitchen crew, receptionists, and ICT managers from the 31 hotels in Tamale, Ghana. The association between IT capacity and competitive advantage was established using a quantitative research approach. Websites, IT systems, and IT infrastructure were all employed in the study to represent IT competence as an independent variable. According to the study, competitive advantage is significantly enhanced by websites, IT infrastructure, and IT systems. In light of this, it was determined that IT capacity has a direct, favorable, and significant link with competitive advantage.

Keywords IT · Capability · Competitive advantage · ICT · IT infrastructure · System · Website

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1 Introduction

The services offered by hotels, restaurants, resorts, and the entertainment sector collectively comprise the hospitality industry [1]. In the Tamale metropolis, a number of structures have been built to promote the hospitality industry's image. This significant stride forward in the economy is the result of a collaboration between the public and private sectors [2]. Hospitality may be defined as the expression of kindness toward visitors or strangers by providing for their basic requirements such as food, drink, and lodging. The primary focus of hospitality is on providing these necessities [3]. The act of fostering a connection between a host and a visitor is often understood to be a contemporary definition of hospitality. Frequently, when we refer to the "Hospitality Industry," we are referring to businesses or organizations that offer tourists housing, food, and/or beverages in addition to other services. However, the term "Hospitality Industry" only applies in the vast majority of situations. The hospitality sector is comprised of a wide variety of businesses and establishments, including hotels and restaurants, which provide a variety of services to customers, including providing food and drink, a place to sleep, and other amenities. Both residents and tourists from other countries are able to purchase these goods and make use of these services.

The hospitality industry has two key business sectors, according to Ghana's Ministry of Tourism (2020): (1) Provide housing (and, in most circumstances, food, and drink) to those who are away from home for whatever reason. (2) Food and beverage: Provide local, commuter, transient, and tourist clients with food and beverages. The major purpose of the hospitality sector is to provide travelers with homes away from home, as well as good service and warm welcomes [4]. The primary constituents are hotels, motels, inns, resorts, and restaurants, which provide shelter, food, and other services to travelers [5]. Ghana's hospitality business has risen from the periphery to the foreground of socio-economic agendas. Ghana is currently ranked 14th in Africa's most visited hospitality industry [6]. Hotel units' importance in the hospitality sector cannot be overstated. The cost of lodging (hotels) accounts for 31% of tourist spending, an average of $1 million each trip [7]. Ghana is quickly moving away from a market-oriented economy with an emphasis on the hotel sector in particular and toward a reliance on secondary commodities. It is commonly acknowledged that the hospitality sector is inextricably related to a nation's potential on the cultural, economic, and intellectual levels.

The use of new technology to improve hotel management operations and customer service has recently gained more attention [8]. This is a result of information technology's advancement and wider adoption in the hospitality sector [9]. Information technology capabilities, which mobilize and deploy IT-based resources in combination with those of other organizational capabilities, may assist improvements in business strategy [10]. Because they adopted new technology, several hotel companies have seen improvements in their financial performance in recent years [10, 11]. However, IT investment can put the lodging industry in danger. New technologies, for example, are frequently made obsolete due to their complexity and implementation

challenges. New technologies typically need increased technological resources and human capabilities [12, 13], as well as, increased system maintenance and operational costs [10, 14].

As hotels in developing economies try to grow their business and market, more hotels are opening up, which has hurt their performance [15]. Organizations have not been able to keep up with changes in the global technology business environment because of things like not taking responsibility for getting new technologies, not having enough technical and networking skills, not having enough human capital, and choosing the wrong technologies [16, 17]. Because of this, foreign elements and goods took over the industrial and commercial worlds [16]. So, African countries have shown that they are committed to improving the region's economy and business by making businesses more competitive locally and globally. This is all part of the African Continental Free Trade Agenda. To do this, the government of Ghana has put in place a number of programmes and policies, such as the ICT4DEV initiative. Hotels often do not get the benefits they expected from their IT investments [18]. Melian-Gonzalez and Bulchand-Gidumal found in 2016 that IT investments in hospitality businesses do not seem to increase hotel revenue. Because of this, research results on how IT skills affect hospitality firms are mixed [10]. There is a big difference in how IT skills affect how competitive a hotel is [19].

Furthermore, while tempting on paper, the concept of IT competence is not well defined, and the process through which IT capability contributes to improved competitive performance is poorly understood [19]. Despite hotels' best efforts to stay successful and grow their businesses, some will fail within five years of their inception [20]. In 2017, more than half of all new businesses failed during the first five years [21]. There is a scarcity of academic studies on hotelier business methods [22]. Successful small business methods have been demonstrated to be beneficial to the success of other small business owners [23]. The basic business challenge is that some IT hotels are negatively impacted by a lack of information capabilities, making it difficult for them to stay profitable and sustain their companies for more than five years [22]. The specific business concern is that certain businesses in Ghana's hospitality industry lack crucial strategies for sustaining their operations beyond five years.

Although various empirical studies have looked at the implications of superior IT competence on company performance on a global scale, few studies have attempted to do so at the industry level, particularly in emerging countries like Ghana. There is very little research on the strategies of information technology capabilities in the hotel industry, in particular [23]. As evidenced by multiple empirical studies, IT remains one of the most effective strategies for eliminating dangers and maximizing possibilities presented by the environment [24]. Despite the fact that some research has started to link IT with a competitive advantage [25], the link between IT and organizational competitive advantage in today's corporate climate is unclear [26]. That means there are few empirical studies of the association between IT and competitive advantage in the previous literature, hence this publication fills that void. Therefore, this study through the resource based view of the firm closes the gap by examining the impact of IT capabilities on the competitive advantage of Ghanaian hotels.

1.1   Research Objectives

The main goal of this study is to find out how IT systems affect a company's ability to be competitive.

1.2   Specific Objectives

1. To look into how IT systems affect competitive advantage.
2. To examine the connection between IT websites and competitive advantage.
3. To look into how IT infrastructure affects competitive advantage.

1.2.1   Significance of the Study

Because of the interdependence between the industrial sector and organisational performance in light of globalization's tough industry competition, this study will be beneficial to Ghanaian economies in emerging Africa. Modern or contemporary entrepreneurial revolution is particularly true in the present economic liberalization. Small and medium-sized businesses (SMEs) are increasingly relying on technology to help them compete in the hotel sector, as they seek tax benefits, subsidies, and environmental incentives.

   Jobs will be created, easing Ghana's graduate unemployment issue and relieving strain on the state sector as a consequence of hotel businesses operating under the self-established entrepreneurial model. As a consequence of this, the IMF's economic dilemma of optimum public labour will be resolved. As a result of better IT capability management, the rural sector will see a reduction in severe abject poverty, especially among illiterates and those with fewer financial means and other vulnerabilities. This will have a positive effect on hotel businesses. Acquiring most economic commodities and products, both goods and services, would catapult Ghana's economy from a middle-income nation to a sophisticated and technologically minded industrial world like Japan, the United States, the United Kingdom or Russia. The IT skills of Ghanaian hotels are being assessed in this research in relation to the moderating impact of competitive advantage.

2   Literature Review

2.1   Ghana's Hospitality Sector

Ghana's hotel business includes hotels, lodges, resorts, inns, motels, guest houses, and hostels. Hotels in Ghana are rated according to a budget grading system used

by the Ghana Tourist Board. 5-stars are the best possible rating, while 1-star is the lowest possible rating. While a hotel typically has a minimum of ten (10) rooms, a guest home often only has four to nine rooms. The number of stars awarded to a hotel is determined by the quality of the facilities and services offered by the establishment (meets international standards). Hotels that are either inexpensive or unrated do not satisfy the requirements of international standards. The size of a hotel does not affect its star rating (in terms of the number of rooms). As a result, depending on the number of rooms, a hotel or guest house can be established [27, 28].

There are around 1000 members of the Ghana Hotels Association (GHA), one of Ghana's most well-known hotel associations. Accommodations, dining, and other tourist amenities in Ghana may be found at one of the hotels and guesthouses that make up the Ghana Hotels Association. These establishments are approved and regulated by the Ghana Tourist Board. One Star to Five Star International standards are incorporated in the membership categories for those who are willing to pay a premium. Hotel membership is open to establishments that meet certain standards, as reported by Narteh et al. [29]. The Ghanaian Ministry of Tourism claimed in 2013 that there were 1751 authorized hotels in Ghana (ranging from one to five stars, economy hotels, and guest houses). 660 hotels in Greater Accra including 183 in the Ashanti area, 183 in the West, 129 in the Eastern region, 126 in the Central region, 87 in the Brong Ahafo region, 87 in the Volta Region, and 85 in the Northern and Upper East regions. Only the Upper West Region's five hotels will be examined for this study, which focuses on the Blue Hill Hotel, Nuoyong Empire Hotel, Sem-B lodge, Upland Hotel, and Queens Valley Hotel. These are all in the Upper West Region (Wa Municipality). According to data provided by the Ministry of Tourism (2013), the total number of hotel rooms in Ghana climbed from 18,752 in 2005 to 26,047 in 2009 as the country went from 1345 to 1775 hotels. According to a study that was compiled by the Ministry of Tourism in 2013, In 2011, there were 1800 hotels in the country as a whole, and by the end of 2017, it was predicted that there would be 2000. According to a Narteh et al. [29] study on Ghana's luxury hotel sector, Accra has the largest density of hotels. This analysis will also take into account all Tamale hotels that have been registered.

2.2   Information Technology (IT)

Because of the independence it has gained from business models, IT has shifted its emphasis to include all aspects of the customer experience [30]. This includes design, communication, distribution, fulfilment, and assessment. One way to approach this is to consider it from the standpoints of conception, dissemination and fulfilment [31, 32]. It has been found that [31, 32]. From the computer reservation systems of the 1970s to the 1980s global distribution systems to the internet in the 1990s to the social interactions of today's consumer-to-consumer virtual networks, the underlying mechanism has undergone significant development. [33]. In 2014, according to Zhu and Morosan, since then, the contemporary economy has been built on knowledge and

information. These factors have a significant impact on production, productivity, and the ability of companies to compete globally. Knowledge and information have also grown in importance over the last several years [34]. Technological advancements have altered the way people communicate, engage, and search for goods, services, and information as a direct consequence of these changes [35]. This study was conducted by Abreu and colleagues in 2017, due to new business models and IT moving ahead on its own with support from business models, IT has evolved to concentrate on the whole customer experience [30]. From the standpoint of design, communication, distribution, and fulfilment, this may be observed [31, 32]. There has been a dramatic shift in the underlying mechanism, from computer reservation systems in the 1970s to internet in the 1990s to today's social network activities amongst consumers [33]. Since then, the contemporary economy has been built on knowledge and information. These factors have a significant impact on production, productivity, and the ability of companies to compete globally. Knowledge and information have also grown in importance over the last several years [34]. Castells [34] says that Technological advancements have altered the way people communicate, engage, and search for goods, services, and information as a direct consequence of these changes [35].

Our lives have been transformed by technology, notably in the hospitality sector [31]. Passengers' access to information, planning trips, and sharing travel experiences has been revolutionized by technology, making the industry more competitive [36, 37]. When it comes to most consumer activities, information technology has taken over and has had deep and revolutionary consequences on the hotel sector [2, 38].

2.3 IT Capabilities

IT capability refers to IT resources that may be utilized to facilitate the sharing of capabilities and services in order to enhance IT's environmental proficiency and assist operations of the business [39]. Information technology has grown in importance in the tourism sector as a result of the significant advantages it provides for all agencies involved, including hotels. IT increases staff productivity, worldwide market share, employee happiness, process standardization, and operating cost reduction. [40, 41]. In recent years, Information technology has advanced significantly and this has had a substantial impact on tourism management [42, 43]. The term "IT capability" can be defined in several different ways.

Antoni et al. [39] proposes an IT capability deployment flexibility method that is connected to the goals of IT and the company, as well as the business design, IT strategies, and IT human resource capabilities. According to Bharadwaj [44], A company's IT competence is defined as its ability to improve performance through the interaction of its IT infrastructure, IT human resources, and IT intangible assets. According to Liu et al. [45], information technology expertise is essential for improving the efficacy and efficiency of organisational operations in order to lessen the adverse effects that business operations have on the environment. The concept of "green computing," according to Harmon and Auseklis [46], merges power management, virtualization,

recycling, the removal of electrical waste, and the enhancement of IT capabilities. The term "green capabilities" is used by Molla et al. [47] to describe an organization's IT and communication resources, as well as shared services and business applications. A growing interest in using new technologies to improve hotel management operations and customer service has emerged as information technology advances in the hospitality sector [8, 9]. Since IT skills may mobilize and deploy IT-based resources in conjunction with other organizational competencies, many hotel businesses have improved their financial performance by embracing new technology [10, 11]. These studies show how a company's competitive edge may be increased by employing IT expertise.

2.4 Dimensions of IT Capabilities in This Study

2.4.1 IT System

The level of competitiveness in the hospitality business is significantly impacted by the use of information technology (IT) systems. Even when other potentially confusing aspects are taken into account, the competitiveness in the hotel industry seems to be driven by IT systems. Despite the fact that Hua et al. [31] came to the conclusion that e-commerce spending had an effect on hotel operational performance, their findings were only supported by contemporaneous research and were limited to analyzing the implications of revenue [19]. It is essential to keep in mind that investments in information technology (IT) systems and websites take some time to pay off in terms of a hotel's capacity to compete with other businesses. Even if information technology systems initially have a detrimental impact on the competitiveness of hotels, such systems seem to have a positive effect on hotel competitiveness one year after they have been purchased. As a parting word of counsel, the results of our study indicate that hotels should keep an adequate number of information technology staff. In order to keep up with its closest competitors in terms of IT performance and operation, the hotel will need to ensure that its IT team is on par with that of its competitors. For IT systems and websites to work properly and positively impact hotel competitiveness, IT labor assistance is required [19].

2.4.2 IT Website

The quality of the information made available on websites, including how simple it is for users to acquire it, how users engage with it, and how quickly they may share it via reviews, has been the focus of earlier study on website capabilities [48]. These studies offered guidance on how to build a profitable website. However, they did not cover all of the qualities essential in the current e-commerce sector. The internet, online networks, and hypermedia technologies are examples of the extremely dynamic and interactive elements present in the contemporary e-business environment. [49].

These traits stand in for a number of e-business startup success factors. Among these characteristics are a user-friendly interface, accurate, complete, and relevant content, history upkeep, and website design. [50]. Previous quality models failed to handle web usability issues such as disorientation and inappropriate information, which the Website capability now addresses [49]. As a result, we've embraced Kim et al. [49], comprehensive Website capability. Because of this, the Website Quality Model incorporates dimensions of information form, substance, and time to help users navigate the site more easily. The Online travel industry was studied by Toufaily et al. [51]. According to their findings, website qualities like usability and customer service quality have a favorable impact on e-satisfaction, which in turn influences client e-loyalty.

2.4.3   IT Infrastructure (ITI)

IT infrastructure (ITI) refers to the basis of IT resources that can be shared to support business operations in organizations through exchanging capabilities and services. ITI is defined by Antoni et al. [39] as important to an organization's capacity to adapt to market change, rethink business procedures, and grow globally or geographically dispersed businesses. Therefore, ITI is a crucial business skill or competency that firms need in order to meet market expectations and achieve their goals. In this study, Antoni [18] and Cassia et al. [52] Use the integrated capability method to identify the IT infrastructure's capabilities that can be used to lessen the environmental effect of business operations. According to Antoni et al. [39], IT infrastructure can help a firm respond to rapidly changing market conditions and technical uncertainty. A role for modularity, simple administrative processes, a central database, external entry points, and the use of storage virtualization is possible [43]. IT is a set of technologies used in corporate strategy that allow for the expansion and maintenance of competitive advantage [53].

IT infrastructure modularity is a method for increasing service to stakeholders by upgrading, deleting, or adding any software, hardware, or data parts of IT infrastructure [54]. Data, software, application module call routines and data conversions are all examples of information systems (IS) processes that may and will be repeated in an organization. A byproduct of this is that the data and applications are now self-contained and reusable. Additionally, they allow direct-purpose systems to be integrated into the infrastructure while streamlining the development, maintenance, and engineering procedures. Information technology infrastructure has a second useful feature: it is capable of doing routine tasks in an intuitive manner [54].

In order to offer uniform services to all business units at a cheaper cost, the simple procedure can be built employing standardization data and information as well as shared services across the entire organization. Therefore, by defining fundamental procedures and standards, a company can leverage such acts to produce environmentally friendly economic operations [55]. An essential component of IT infrastructure that can aid a company in enhancing its environmental performance is a centralized database management system [39]. This is because a key component of the business

process that can be leveraged to enhance environmental performance is the central database.

2.4.4   Competitive Advantage

A company's capacity to surpass its rivals in terms of a product, service, or knowledge is considered as competitive advantage [56]. Only a comprehensive plan that considers a company's marketing, operations and supply chain, human resources, finances, and technology may lead to long-term competitive advantage [57]. Utilizing all of an organization's resources effectively has an impact on its performance in the market [58]. An rise in market share or profit over the competition is a sign of competitive advantage [59] either (a) cutting product costs to lower the price or (b) differentiating a product to increase the price. Any of these two strategies can be used to gain a competitive edge [60]. Making their items distinctive from the competition might give them a competitive edge [61]. Branding is a sort of uniqueness that might influence a customer's decision to purchase a certain product [62]. In the case of hotels that are located close to one other, product diversification is particularly effective for reducing direct competition and developing new competitive advantages. High agglomeration and easy access to inputs, as well as high exit barriers and low switching costs for customers, make the hotel and tourist industry more competitive than other businesses. An examination of 4257 hotels in Texas utilizing quantitative research by Lee [63] uncovered a link between quality differences in hotel accommodations and regional pricing competition. Lee came to the conclusion that if the quality of the hotels in the immediate neighborhood is equivalent, there is a lot of price competition. However, regional competition grows when a hotel's quality level restricts the substitutability of its products.

According to Lee [63] price competition among similar hotels was less intense than expected. According to Lee, inefficient price competition may be reduced by correctly identifying rivals. An example of an intangible and immovable benefit is one's skills and reputation [60]. Companies are more likely to stay in business if they focus on their "intangible assets" instead of their "physical assets [64]. Human capital can be made into a sustainable competitive advantage by implementing a comprehensive human resources management program that prioritizes employee motivation [65]. Quantitative research of 34 independently owned hotels in Serbia was conducted by Bontis et al. [66] to examine the relationship between intellectual capital and financial performance. Intellectual capital had no statistically significant impact on the financial success of hotels, according to Bontis and his associates. This covers elements like employee competencies, client relationships, and organizational culture.

2.5   Theoretical Underpinning

2.5.1   Resources-Based View (RBV)

According to the RBV theory, an organization's internal traits and its competitive advantage are linked [67]. Enterprises in the same industry have a variety of resources, according to the hypothesis [68, 69]. In-depth viewpoint has emerged as prevalent explanations or theories paradigm for analyzing performance [67]. There are three categories of resources that might have an impact on the production of a company: physical resources, human resources, and organisational resources. To run a successful business, a corporation needs all three of these different kinds of resources [70]. According to the Resource Based Theory (RBT), which has been the subject of research, the comparative advantage of a company may be constructed from its capabilities and resources [71–73]. Thus, RBV focuses on long-term competitive advantages and considers both tangible and intangible assets while conducting its analyses.

Resource-based theory (RBT), according to Barney [74, 75], argues that a company must amass valuable, rare, inimitable, and non-substitutable (VRIN) resources and abilities if it is to achieve a state of sustainable competitive advantage. The percentage of resources capable of coping with an increasing workload is known as capacity [75]. Building and constantly managing the capacity of a company to produce outstanding returns is a common definition of a business. Each business has a unique set of strategic capabilities that form the basis of its long-term plans and are essential to its financial success [67].

2.6   Conceptual Framework

2.6.1   IT Capabilities and Competitiveness

The hotel industry has reaped the rewards of technological advancements and has come to appreciate the advantages of IT. As an example, the internet and social media have long been used to promote and sell hotel products and services [10]. Hotel owners that have their own websites are more likely to see an increase in sales since they have direct touch with their clients. In addition, these initiatives will be vital in helping hotel companies identify consumer habits since hotel corporations and consumers are engaging in the same spot [19].

IT-enabled information exchanges are critical to the hotel and tourist sectors because they have a significant influence on the business's essential principles [35]. In the last two decades, academic research on the effects of widespread IT adoption and use on performance has increased dramatically [44, 76]. This is due to the fact that information technology has become so pervasive in people's daily lives and is a critical organizational capability [31, 77]. Other industries, such as manufacturing

[78] and the service sector [79], have looked into the impact of IT capabilities on competitiveness, but the hospitality industry has yet to conduct a systematic study of how IT capabilities impact hotel competitiveness.

To develop competencies, support companies on both the supply and demand sides will need to make investments in their information technology skills [80, 81]. Hotel firms may enhance their goods and services, strengthen organisational capacities, and accomplish strategic objectives by developing and using IT capabilities, which can provide them a competitive edge in the marketplace [37]. Previous studies have shown that talents in the information technology sector may assist in the enhancement of product and service offerings [19].

There have been significant changes in the hotel and tourist industry as a consequence of internet and social media-based promotions [38]. The bottom line is that organisations now rely heavily on information technology as a means of staying ahead of the competition [82]. A firm's IT human capital, infrastructure, and relational resources have been defined as three important categories of IT resources, based on Grant's [83] resource categorization [84, 85]. All hotel IT expenses are recorded and divided into three categories, which correspond to the above-mentioned three IT capabilities: IT personnel, systems, and websites. As a result this study presents the following alternative hypotheses:

H1: There is a significant positive relationship between IT systems and competitive advantage.

H1: There is a significant positive relationship between IT websites and competitive advantage.

H1: There is a significant positive relationship between IT infrastructure and competitive advantage (Fig. 1).
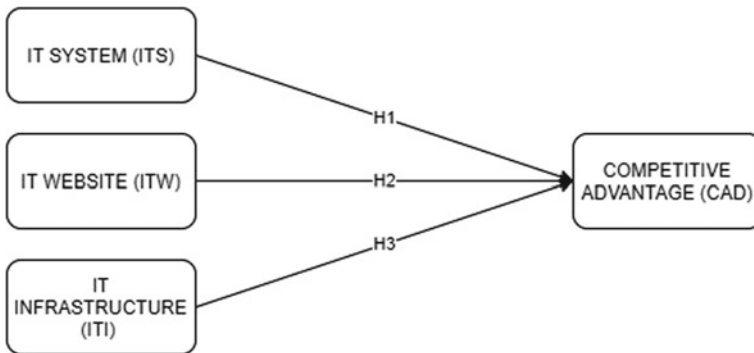
Fig. 1 Conceptual model

3 Methodology

3.1 Research Design

Quantitative designs come in a wide variety of forms, such as experimental, quasi-experimental, and non-experimental ones [86]. For this study, a correlational model was the most suitable quantitative approach. Bettany-Saltikov and Whittaker [87] advise utilising correlational designs for measuring two or more quantitative variables from the same sample of participants.

The researchers determined that a quantitative method would be the most suitable for this examination given that the goal of the study is to find relationships. According to McCusker and Gunaydin [88], the design of a number of study components occurs prior to the collection of data in quantitative research. The researcher is able to retain objectivity and distance from the subject of the investigation while being aware of the study's objective [88].

3.2 Population and Sampling

Participants in the research had to be at least 18 years old and full-time workers in customer service at a front desk working at a hotel in Tamale, Ghana. They had to have a minimum of one year of prior experience. Online surveys were used to poll the target population of front desk and customer service professionals, including kitchen staff, receptionists, hotel management, and ICT managers, to find out how well they understood IT skills and how they affected competitive advantage. The 31 hotels in Tamale, Ghana were the study's target audience, and 153 respondents were selected from among managers, kitchen employees, receptionists, and ICT managers. Due to the potential influence of that company's distinctive corporate culture, there is a higher risk of bias when the sample is limited to only one organisation [89]. A sample of 153 respondents was chosen at random from the general public using the basic random sampling method. This was done on purpose to collect the necessary information from the respondents in order to assist in achieving the goals of the research. Because of the composition of the population of hotels in Tamale, the approach of simple random sampling is the one that is most suitable for use in order to guarantee that every responder has an equal opportunity of being included in the sample.

3.3 Data Collection Technique

Using online questionnaires, quantitative data may be gathered fast and efficiently [90]. To avoid the lower response and completion rates and higher expenses of

traditional survey methods like paper, email, or social media, we used an online survey created with the help of the qualtrics website instead. An online survey's benefits include its simplicity of use, quickness of deployment and cheap cost. The respondents' convenience is also a major factor in the popularity of an online survey [91]. The poor response rates, sampling biases and difficulty to reach persons with restricted Internet access that may occur while conducting online surveys are some of the downsides [92].

3.4 Instrument of Data Collection

A variety of instruments are used to gather information, including questionnaires, interviews, focus groups, surveys, and casual observations. A wide range of devices may be used to gather data, but which one is ideal depends on the kind of study being done. Accordingly, we employed a questionnaire to gather information from hotel workers responses's. The Likert scale was used in the investigation. A scale of 1–5 is used to measure participants' agreement or disagreement with each of the statements: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree [93]. However, the open-ended questions elicited participants' thoughts and ideas rather than providing answers to prepared close-ended questions.

3.5 Data Analysis

The statistical and graphical data analysis apps IBM SPSS 25.0 and Amos 24.0 are for Windows [94]. Pearson's correlation coefficient analysis, descriptive statistics, and structural equation modeling are all included in this software to explain the general distributions in terms of frequency and percentage [94]. Analyzing large datasets with AMOS is a strong tool that can predict the relationships between multiple independent and dependent variables [95]. SPSS-Amos was used to evaluate the connections between IT Capabilities components and extrinsic and dependent competitive advantage variables. Three different hypotheses were accepted or rejected based on the conclusions drawn from the responses of the participants. By examining the associations between a large number of various independent variables as well as the variation of those relationships, SEM can be used to predict the outcome of a response variable [96].

It is possible to calculate central trends using descriptive statistics, such as minimums and means [94]. Helps estimate the overall distribution if you know the frequency and percentage levels of each variable [94]. Descriptive statistics were employed to evaluate the data in order to have a better understanding of the demographics of the survey respondents. Computer-aided surveys are certain to have information gaps, claims Bryman [97]. All of the previously gathered survey responses were removed from consideration to create place for the new data.

3.6 Measures

The five-point Likert Scale was used in this study to adjust all of the measurements that were taken from the previous research. The three different constructions that make up IT capabilities were borrowed from Salisu and Bakar [15], whereas the many things that make up competitive advantage were borrowed from Radomska et al. [98]. The information on the item and scales may be found in Table 1.

Table 1 Measures and scales

IT website (Salisu and Bakar 2019)
Our company website is designed for customers to interact with
Our firm website has the capacity to attract and hire talented experts
Our company website is attractive to people/visitors
Our company website friendly to use
Our company website has all our services on it
IT system (Salisu and Bakar 2019)
Our company is one of those firms in the industry that establish technology standard
Our company leads in technology innovation in the industry we operate
Our company makes sufficient investment in R&D activities
Our company improves technical skills through continuous training programs
Our company has the monitoring capacity to accurately predict changes in the technological environment
IT infrastructure (ITI) (Salisu and Bakar 2019)
Modularisation of information systems functions
Implementation of simple administrative procedures and rules
Adoption of centralised database management systems
Adoption of extranets as entry points for external users
Adoption of virtualisation technology for improving data processing in business transactions
Competitive Advantage (Radomska et al. 2019)
Our company's sales performance has improved significantly
Increase in customer numbers (Market share)
We set new standards (technological, product, organizational, etc.) in the industry
The competitive advantage of our company is based on revenue

Table 2 Response rate

Respondents	Targeted	Actual response	Percentage	Non-response	Percentage
Manager	95	79	83.2	16	16.8
Receptionist	19	16	84.2	3	15.8
ICT manager	28	24	*85.7*	4	14.3
Kitchen staff	11	8	72.7	3	27.3
Total	153	127	83	26	17

3.7 Results

3.7.1 Response Rate

The study targeted 153 respondents drawn from managers, kitchen staff, receptionists, and ICT managers of the 31 hotels in Tamale-Ghana. The response rate was distributed as shown in Table 2.

According to the findings shown in Table 2, an overall total of 127 targeted respondents provided their responses to the research instrument, which represents a response rate of 83.0%. The vast majority of responders (95) were managers, although information and communications technology managers provided the fewest responses. In terms of percentages, the response rate that was seen for ICT Manager was the greatest at 85.7%, while the response rate that was recorded for kitchen staff was the lowest at 72.7%. Based on these findings, it appears that the ICT Managers, managers, and receptionists who are officers in the hotels were more likely to be available in their offices than the kitchen staff, who are primarily responsible for preparing meals for guests and clients. This is because the kitchen staff is kept busy by the act of cooking.

3.7.2 Demographic Information

The respondent's overall characteristics are referred to as the respondent's demographic information. According to the recommendations made by the researchers, the demographic survey is made up of five free-form questions that are meant to collect the most up-to-date personal information about employees, such as their age range, gender, level of education, line of work, and number of years of employment [94]. The percentage distributions of the demographic variables were summarized and described, we performed an analysis of the demographic answers using a statistical technique known as descriptive statistics. This study specifically, includes gender, educational level, position held, and employee tenure (no. of years worked for the hotel). See Table 3.

54.3% of the respondents were male, according to the data in Table 2. For this reason, it can be concluded that this study was not skewed toward one gender or another. Managers accounted for 62.2% of those surveyed, while ICT managers

Table 3 Demographic information

Indicators	Frequency	Percentage
Gender		
Male	69	54.3
Female	58	45.7
Total	127	100
Level of education		
Diploma	103	81.1
Undergraduate	16	12.6
Postgraduate	8	6.3
Total	127	100
Position held		
Manager	79	62.2
Receptionist	16	12.6
ICT manager	24	18.9
Kitchen staff	8	6.3
Total	127	100
Years worked in the hotel		
<One year	8	6.3
1–5 years	16	12.6
6–10 years	86	67.7
>10 years	17	13.4
Total	127	100

accounted for 6.3%. With regard to educational attainment, postgraduate degree holders had the highest frequency (81.1%), while diploma holders had the lowest (6.3%). This suggests that majority of the staff hold either a bachelor's degree or a master's degree. The majority of respondents (67.7%) had worked in the institutions for between six and ten years when asked about their tenure. Those who had worked for more than ten years made up 13.4% of the sample. According to the findings, the majority of respondents provided credible information in their responses.

3.7.3 Reliability and Validity

This table shows that Cronbach alpha (α) and the composite reliability (CR) are both in the "acceptable" range. The Cronbach's alpha values of all of the variables are greater than the 0.6 thresholds [99]. It was also decided that all variables must have composite reliability of at least 0.70. Each variable's average variance is higher than the 0.50 convergent validity cutoff, as shown in the table. In Hair et al. [100], since each variable must represent a distinct phenomenon, we use the Fornell and Larcker [101] criteria to determine their discriminant validity (Table 4).

Table 4 Reliability and validity

Constructs	Items	Loadings	α	rho_A	CR	AVE
IT systems			0.93	0.94	0.94	0.68
	ITS1	0.77				
	ITS2	0.87				
	ITS3	0.74				
	ITS4	0.75				
	ITS5	0.71				
IT website			0.95	0.93	0.95	0.56
	ITW1	0.82				
	ITW2	0.75				
	ITW3	0.76				
	ITW4	0.73				
	ITW5	0.77				
	ITW6	0.71				
	ITW7	0.72				
IT infrastructure (ITI)			0.94	0.89	0.82	0.72
	ITI1	0.82				
	ITI2	0.75				
	ITI3	0.72				
	ITI4	0.73				
	ITI5	0.70				
Competitive advantage (CAD)			0.92	0.94	0.93	0.76
	CAD1	0.82				
	CAD2	0.75				
	CAD3	0.77				
	CAD4	0.72				
	CAD5	0.72				

3.7.4 Correlation Analysis

Jobson claims that correlation analysis can be utilised to ascertain whether variables in the study have a significant relationship with one another (2012). The correlation analysis findings are displayed in Table 5. The values of the square correlations between the construct pairings are bigger than the values of the discriminant and convergent validity, as shown in Table 5.

Using a confirmatory factor analysis (CFA), we were able to ensure that the concept was reliable and valid. CFA is a technique for assessing the accuracy with which a set of measurable variables represents a set of conceptual constructs [100].

Table 5 Discriminant validity and correlation

	AVE	ITS	ITW	ITI	CAD
ITS	0.68	*0.82*			
ITW	0.56	0.65	*0.75*		
ITI	0.72	0.58	0.59	*0.85*	
CAD	0.76	0.55	0.60	0.65	*0.87*
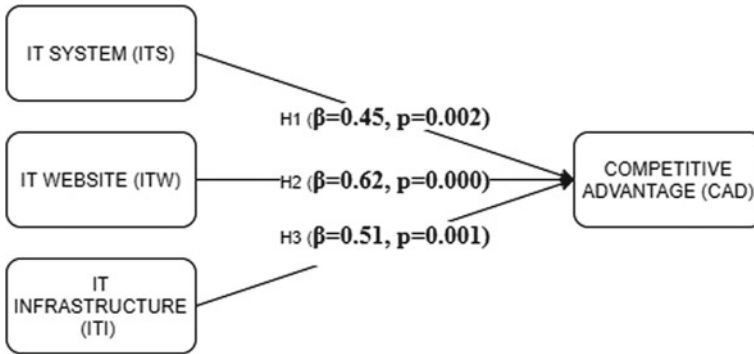
Fig. 2 Paths

Discriminant validity is demonstrated by AVE values greater than the square of the correlation between a pair of components [100]. Discriminant validity is indicated by AVE values greater than squared correlation, as seen in Table 4 (Fig. 2).

3.7.5 Hypothesis Result

Structural Equation Modelling (SEM) was used to test the three hypotheses in Amos. The t-test, beta values (β), and probability values (p) were the indicators used in assessing the relationships.

An analysis using data from Table 6 shows that there is a significant and positive relationship between IT systems and competitive advantage (t = 12.47, =0.45, and p = 0.002). As a result, hypothesis one (H1) is confirmed. According to Table 6's results, IT websites have a significant and positive relationship with competitive advantage (t = 16.26; =0.62; and p = 0.000), which supports hypothesis two (H2). Final reports show that IT systems have a significant and positive relation with competitive advantage (t = 13.42; =0.51 and p = 0.001), which confirms hypothesis three. According to the study, hotels in emerging markets like Ghana can gain a competitive advantage through the use of IT capabilities.

Table 6 Hypothesis/Paths

Paths	Hypothesis	Original sample	Sample mean (M)	SD	t-statistics	β	p-value
ITS → CAD	H1	0.193	0.202	0.060	12.47	0.45	0.002
ITW → CAD	H2	0.613	0.546	0.056	16.26	0.62	0.000
ITI → CAD	H3	0.611	0.603	0.076	13.42	0.51	0.001

3.7.6 Summary of Findings

Examining how IT capabilities affect hotels' competitive advantage in Ghana was the aim of this study. According to the report, hotels with IT capabilities may be able to obtain a competitive edge in developing areas like Ghana.

IT systems have a significant and favorable relationship with competitive advantage, according to analysis of Table 6 (t = 12.47; =0.45 and p = 0.002). So, the first hypothesis (H1) is confirmed. Second, data from Table 6's analysis indicate that there is a significant and favorable relationship between IT websites and competitive advantage (t = 16.26; = 0.62 and p = 0.000), supporting hypothesis two (H2). Finally, Reports from the analysis from Table 6 shows that IT systems have a significant and positive relation with competitive advantage (t = 13.42; β = 0.51 and p = 0.001), which confirms hypothesis three (H3).

4 Conclusion

The significance of learning IT applications in the hotel business has recently been highlighted. In this regard, the empirical validation of a scale of IT uses in the hotel environment, which distinguishes three categories of IT capabilities, is an important theoretical contribution of this study (IT system, infrastructure, and website capabilities). This typology encompasses both back and front office operations, as well as partnerships with other industry stakeholders.

Using impact testing on specific IT capabilities, we can see how they affect hotel competition directly. These experiments show that not only do unique IT capabilities have diverse implications on hotel competition, but they also require time to manifest and have an impact on hotel competitiveness. Investments in IT infrastructure provide long-term advantages for hotels' competitiveness, according to this study's results, even when they interrupt daily operations in the short term.

An organisation may build operational capabilities and enhance performance by using IT to identify, acquire, and apply fresh external information. The success of a company's new product creation and performance is influenced by the company's IT ability to create and deliver new goods and services more efficiently and effectively that best matches customer requirements. In a rapidly changing business environment, hotels equipped with technology capabilities can endure the repercussions

for the long term. For hotels in Ghana, on the other hand, it is necessary to adapt their strategic technical planning in order to ensure considerable investment in R&D, continuous training, and the use of new technologies in problem-solving procedures that promote competitive advantage and boost performance.

5 Recommendations

This study also makes some significant contributions from a managerial standpoint. IT skills should be given strategic importance when resource allocation choices are made in order to achieve competitive advantages. IT skills are vital for hotel competitiveness, but this research also successfully offers actual proof that a hotel may improve its market share among rivals in the same city and chain size in the same industry. The research also found that various IT skills are affected by expenditure in different ways. These expenditures have immediate as well as long-term repercussions, as they show. It is important to remember that IT systems and websites take time to pay off in terms of a hotel's ability to compete. A year after purchase, IT systems seem to have a good influence on hotel competitiveness, even if they initially have a negative effect. Investment in IT systems looks to pay off in the long term, despite the immediate negative impact. However, these impacts are less obvious and take longer to materialize. Expenditures on IT Websites look to be worth the money after a year of use; the present advantages may balance these expenses, resulting in little immediate effect.

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Start of Telemedicine in Uzbekistan. Technological Availability

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Abstract This report discusses the state of the technological base for the widespread introduction of telemedicine technologies in the practice of healthcare in the Republic of Uzbekistan today. The directions of telemedicine are singled out, which have different requirements for technological equipment, and the requirements for various components of the hardware and software of these areas are formulated. What are the most common options that have been applied over the past two decades in Uzbekistan, such as clinical telemedicine, i.e. conducting remote consultations and consultations (teleconsultations and teleconcilia) between medical institutions, during which the attending physician receives assistance from colleagues of higher qualification in making a diagnosis and clarifying treatment tactics. What are the real problems facing the health care of the Republic of Uzbekistan on the way to the implementation of high-quality telemedicine in the country are discussed. The nuances that prevent the republic from being at the level of leading countries are revealed. Conclusions are drawn about the insufficient technological readiness of modern health care within the country to introduce the most promising areas of telemedicine and about the wide opportunities for developers of digital medical equipment and telecommunications programs.

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1   Introduction

Telemedicine, as a new organizational and technological direction in the delivery of health care, is officially permitted from 06.10.2020, in accordance with the Presidential Decree No. UP-6079 of 05.10.2020 On Approval of the Strategy of Digital Uzbekistan-2030 and Measures for its Effective Implementation [1]. Taking into account the fact that in the last 5 years the country has seen a massive introduction of information technologies, one would expect that by early 2022, if not all, then almost all the problems that could hinder the widespread introduction of telemedicine, have already been solved. Alas, this is far from being the case.

Given the subject matter of this conference, we will not dwell on the legal, organisational, human resource and economic issues involved, but will consider only the technological aspects. The World Health Organization (WHO) has defined telemedicine as "the delivery of health care services in settings where distance is a critical factor, by health care professionals using information and communication technology (ICT) to share essential information for the diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care professionals to improve public health and community development" [2, 3].

It is with this definition in mind that we will not look at the various aspects of ICT applications that perform support functions, such as making appointments online or obtaining copies of medical records for patients via the Internet, but rather focus directly on the technological challenges of remote health care delivery.

2   Problems of Telemedicine in the Republic of Uzbekistan

For the most widespread option over the past two decades in Uzbekistan—clinical telemedicine, i.e., remote consultations and consiliums (teleconsultations and teleconsiliums) between medical institutions, during which the attending physician receives assistance from more highly qualified colleagues in making a diagnosis and clarifying treatment tactics—most technological problems have now been solved. There are videoconferencing facilities, there are telecommunication channels with sufficient bandwidth, there are technical facilities for digitizing documents and medical images on transparent media, and there are medical information systems (MIS) of medical institutions, where information about each patient is stored in their electronic medical record (EHR). Two doctors (or groups of doctors) can easily exchange relevant information for the benefit of the patient, with or without his presence, and if necessary, carry out remote diagnostic sessions in real time. Perhaps it is only real-time remote diagnostics that are not always supported by modern digital technology. For example, some hospitals are using outdated ultrasound devices that only have an analogue (S-Video) signal output, but there is an

obvious technological solution to this problem. For real-time transmission of an ultrasound image to a consultant it is sufficient to use a computer connected to the Internet that has a video capture card (S-Video signal digitization) and video conferencing software that supports dual-streaming video mode according to the International Telecommunication Union (ITU-T) H.239 Standard [4].

There are many more technological problems in two other variants: mobile telemedicine, when counselling medical care is provided in emergency situations or the temporary stay of organised contingents in sparsely populated or unpopulated areas without medical facilities and sufficiently qualified medical personnel, and personal telemedicine, when counselling medical care is provided remotely to a patient with no medical personnel nearby, based on the use of information and telecommunication technologies [5].

3 Problem Solving Methods

Let's start with mobile telemedicine. Obviously, in sparsely populated or unpopulated areas there are no terrestrial links, except perhaps at a few locations near major gas/oil pipelines or railways where there are fibre optic backbone nodes. In other cases, telemedicine sessions could only be conducted using satellite links. Currently, there are three technologies that are suitable for videoconferencing:

1. Relatively narrow bandwidth via Inmarsat channels. Inmarsat-BGAN terminals allow communication sessions at speeds of up to 492 kbps, which is insufficient for the transmission of two-stream video of the required quality, but can be used to communicate with a consultant and to transmit files from diagnostic equipment in delayed mode.
2. V-sat terminals with relatively small antenna diameters (less than 2.5 m) and a number of satellite communication networks from providers such as STECOM [6]. The bandwidth is sufficient for videoconferencing (VCS) sessions of proper quality, including dual-stream video, but the permitting procedure complicates the use of these channels in sparsely populated or unpopulated areas.
3. Mini-VSAT terminals which are positioned as the most modern variant of satellite communication for sea ships, however, the coverage zone of this system covers the most part of land, except for some polar areas of northern hemisphere and Antarctica [7].

From our point of view, the most promising for mobile telemedicine is the STEKCOM range of services, as it provides a greater variety of channels and technologies, including Inmarsat-BGAN and V-sat, including the mobile channel. However, the technological challenges of mobile telemedicine are not limited to the selection and subscription of appropriate communication channels and satellite terminals. Since in sparsely populated or unpopulated areas there are not only

no terrestrial communication channels, but also no highly qualified medical professionals, for telemedicine consultation it is necessary to provide both the VCS terminals themselves, which allow easy connection of medical diagnostic equipment, and the medical equipment itself which is suitable for field use (portable, low power, easy to operate, etc.). This makes it possible to carry out remote diagnostic sessions where there are no qualified medical professionals near the patient, but where there are hardware and software packages that allow the output of the diagnostic device to be transmitted to the consultant.

A mobile videoconferencing terminal suitable for use as part of mobile telemedicine complexes (MTMC) has a number of requirements, which are not fully met by commercially available mobile videoconferencing facilities of foreign manufacturers [8–11].

Obviously, it should be airtight (dust/moisture proof) in transport position, and have high vibration/shock resistance. But these qualities are not enough.

Firstly, it must additionally have universal power supply: built-in batteries with sufficient capacity for 2–3 h video communication sessions and possibility of connection to external power supply (~110–250 V, 50/60 Hz, 12 V and 24 VDC) both for charging of batteries and for work.

Secondly, it allows you to connect a variety of diagnostic equipment via standard ports: USB, RJ-45, HDMI, RS-232, S-Video.

Thirdly, it enables installation of diagnostic hardware and software on the terminal itself and transmission of its output forms as a source of one of the real-time video streams.

Fourthly, it enables connection of one or two external monitors (projectors) for dual-stream operation.

The requirements for automated medical diagnostics hardware and software are no less stringent. In addition to requirements for dust/moisture resistance in the transport position, and high vibration/shock resistance, they should possess a number of functional qualities, such as: portability and low weight; low power consumption; ease of use by unskilled personnel (in the extreme—complete absence of hardware control); integration with VCS terminals; high information value of implemented techniques; high level of automation and user-friendly interface, allowing the remote consultant to make informed decisions; ability to document remote diagnostic results; no or the absence or availability and low cost of consumables.

We have developed and certified a VCS terminal that meets the above requirements and proposed a number of MTMC based on these terminal and medical diagnostic tools with the required qualities [12, 13]. Turning to personal telemedicine (PTM), it seems possible to reduce the requirements: after all, neither harsh climatic conditions nor transport jolts are foreseen. However, to the aforementioned functional requirements new ones related to the absence of medical specialists near the patient are added. Since PTMs are potentially the most capacious market for digital telemedicine technology, let's take a closer look at it.

It is clear that PTM is a new organisational and technological area of outpatient care. Modern information and telecommunication technologies make it possible to make a significant part of the monitoring of chronic patients, the patronage

of pregnant women, disabled and post-operative patients and the rehabilitation of convalescents after inpatient care available remotely.

4   How to Implement the Proposed Methods?

In order to realise this potential, let us first answer the question: what should the telecommunication structure of personal telemedicine be?

Today, almost every urban flat has a high-speed internet connection. In rural areas, this is somewhat worse, but the gap is rapidly closing. It is the Internet that should be the communication environment for PTMs. However, it must be considered that information must circulate between the patient's home and the outpatient's MIS, hence the problem of its protection in accordance with the On Personal Data law No. ZRU-547 [14] of 02.07.2019. The most likely solution is the application of VPN (Virtual Private Network) technologies overlaid on the Internet. This, in its turn, requires a large number of specialists to apply this technology not only in polyclinics, but also in patients' flats but the vast majority of Internet users have no idea about VPNs, and should not engage in network administration. The lack of such specialists at the polyclinics themselves can be compensated by hiring specialised firms on an outsourcing basis or by creating a service at the local health authority, but this is not a technological issue any more. In addition to network infrastructure, PTM will require extensive use of videoconferencing software for full communication between outpatient clinic doctors and patients and/or their relatives back home. The widespread Skype and a number of other free services are not suitable for this, as their servers are outside the control of medical institutions and health authorities, which contradicts ZRU-547.

What are the characteristics of a communication platform suitable for widespread implementation of PTMs? First of all, it should be a fundamentally software-based solution, i.e. based on relatively inexpensive computers of wide application, in extreme case all types from network servers to smartphones. In addition, a software server of multipoint VCS in clinics should support parallel operation of multiple virtual "meeting rooms". This is necessary both for the responsiveness of call centre operators responding to multiple patients simultaneously and for physicians/facilitators conducting group sessions for remote rehabilitation or scanning surveys of patronized patients.

However, the most challenging requirement, in our opinion, is the need to transfer objective information from the patient's diagnostic equipment via their personal computer to their EIB within the MIS of the polyclinic. Naturally, information security requirements must be met. In doing so, patient's software should transmit data from diagnostic equipment connected to a computer during VCS session, and a server should receive it, securely access MIS, enter it into EIB of a particular patient and notify appropriate doctor/physician regarding availability of new information about this patient. Accordingly, a patient covered by one of the PTM programmes should have an automated diagnostic technique integrated with a computer whose software

should default to sending the recorded information to the correct address in an agreed digital format during a remote diagnostic session conducted in parallel with the VCS communication. Both the diagnostic technology itself and the interface of its software should be kept as simple as possible so that it can be used by an entry-level computer user, which includes many older patients and their relatives.

5   Conclusion

Today's medical diagnostics market is mainly intended for use by professionals in medical institutions, but the multitude of gadgets for personal monitoring of individual body functions that have appeared in recent years generally do not stand up to serious criticism, both in terms of metrology and the information content of the data obtained.

Given the cost of most medical diagnostic equipment, the likelihood of equipping a patient with multiple certified functional diagnostic hardware and software is extremely low. Consequently, widespread implementation of PTMs will require the creation and certification of fundamentally new diagnostic tools that combine the capabilities of several functional state monitoring techniques, with new digital processing algorithms that allow extracting more information from a smaller number of signals recorded from the patient. The feasibility of fulfilling the above-mentioned requirements is well illustrated by the increasing implementation of mathematical analysis of heart rhythm or hardware-software means of personal remote heart condition monitoring Cardiovisor into clinical practice. [15].

To summarise, the official launch of telemedicine technology has provided the developers of digital medical technology and digital health information processing with a wide field of action, promising good commercial prospects.

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Comparative Analysis of Convolutional and Long Term Short Memory Architectures in Machine Learning

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Abstract Training machines to develop intelligence is one of the popular studies of computer science. As long as machines with human intelligence is used for the benefits of humans, this technology will flourish civilization. Digital data capturing may process numerous challenges as documents may contain a combination of multiple unstructured data types. Such documents are easily readable to a human but machines may be unable to interpret the data as humans do. Neural network approaches like multilayer perceptron, CNN, RNN and LSTN are effective recognition methods as it can effectively deal with complex computing problems related to training networks and in the process of automating and producing predictive results. In deep neural networks, machines can detect prominent features of a given object without human interventions. The classification and recognition rate of all present algorithms depend chiefly on input images. This paper presents two approaches of deep learning for document recognition problem, convolutional neural network and the result of CNN is continued to RNN and LSTM approaches for synthesizing document. The study attempts to compare the results of CNN vs CNN-LSTM in terms of precision rate.

Keywords Neural network · Convolutional neural network · Long-term short memory

1 Introduction

Discovering patterns and data extraction from the data sets were common in early 1990s. Over the years, machines have taken the role of human operations and character recognition is one such a field where machines have taken the role of humans to interpret written documents. Techniques like support vector machines eliminated

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the difficulties faced during template matching as they dealt with large sample data and improved the accuracy level. But as the volume of data grew significantly larger, new and powerful methods of machine learning evolved. In learning process, data is gathered from the training sets to create a classifier. Learning is performed to reduce the error rate in the training set. Network is designed and trained with training set so that it can classify the target samples. Neural network is a machine learning approach used for recognizing characters, image manipulations, data extraction, handling time series, data forecasting and so on. The big data has taken attention in various fields like business, science and industry. ANN technology has power to forecast demands accurately. It uses mathematical approaches and aims to teach machines to detect, sense and learn as humans do. Researches are developing decision making algorithms to accomplish this complex task of mimicking human brain that can compute, store, predict and identify information by creating set of interconnected artificial neurons which resemble human brain neuron. The basic form of neural network called as perceptron was designed in 1950s. NN architecture consists of nodes arranged in layers. Input features are given to input layer, which is then added with a given weight and passed to the next layer. Resultant output is matched with models outputs and weights are adjusted. Recurrent neural network provides dynamic artificial memory for machines by using feedback approach. Long short term memory is a special form of recurrent neural network and portrays better performance in terms of processing speed and predicting time series [1]. This paper deals with discussions about the advantages of approaches used in learning techniques and compares the recognition rates of CNN and LSTM for character recognition. In this experiment, a hybrid approach of CNN and LSTM network is applied.

Section 2 of this paper is the literature survey. Section 3 describes different steps recognition approaches. Section 4 introduces classification techniques. Section 5 discusses the methodology CNN and CNN-LSTM network architectures. Section 6 is shows the results of the experiment and Sect. 7 projects future plans.

2 Literature Survey

Literature study shows many methods published to transfer grey-images to its binary form. The performance of several global algorithms were studied. Otsu reparability method exhibits the best results. But studies by Rosin and Ioannidis stated that the performance of Otsu algorithm faired poor compared to other techniques. Trier and Jain showed that Otsu method exhibited better than any other techniques. OCR classification can be classified as statistical, neural networks, template-matching. Studies show that template matching though is the simplest, the identification rate of this approach is sensitive to noise/illumination. Diagonal based feature extraction method is used for handwritten alphabets recognition employing neural network [2]. Sharma, Om Prakash et al. proposed an enhanced feature extraction model utilizing Euler number for alphabet/pattern recognition [3]. Two major classes of features: statistical and structural, was proposed by Sahu [4]. The vast success rate of the RNN

models on handwriting recognition, speech [5, 6] and image recognition [7, 8] has inspired this study. CNN operates on spatial image features and are static convolution models. Since RNN lacks feature extraction ability, a hybrid architecture of the two models are used for text recognition and the visual features extracted are input to LSTM.

3 Recognition Methodology

3.1 Data Capture

Data is captured from documents using OCR. A text layer of the document is generated and data fields are recognized. Text-based rules are applied to segment the text. In this paper a novel approach of deep learning technique using spatial OCR is also used. A space map is built for every letter which is recognized. Just like humans have ability to focus on specific spots which contain key information, neural approach for data localization using Rossum's algorithm is used. Using this approach focus is given to the specific spot where data is contained. The precise boundary is determined from the focal points and 95% of the data can be extracted using Rossum's algorithm. Scanners are also used to scan the image, which then is stored electronically in jpeg, bmp etc. formats. Images will have various shades of black and white. The image is binarized and converted into its binary (0 and 1) form by applying certain threshold values. Thresholding divides image into two, foreground and background and ignores the other shades. The output of thresholding produces BW (black and white) images. In this work, integral image approach is used to reduce the computational time. Non-significant objects from the image is eliminated and only significant data is gathered. The output thus obtained will yield an image with reduced bumps, noise and other disturbances. Scanned images will be skewed and the skewness in the image is corrected by calculating the skew angles and the slant in lines from horizontal or vertical axis. In the proposed method, skew angle of deviation of line (θ) is determined for ±70 °. Proposed method uses Hough Transform to eliminate skewness for 70 ° rotation of text. Most likely horizontal and vertical strokes are calculated so that character of small size length are not left out. Thinning is performed and this operation skeletonizes images by eliminating certain pixels from the contour of the text till it is one-pixel wide. Image is segmented so that the text divides the input into lines, words and characters so that they can be accurately recognized. Depending upon the line segments, horizontal and vertical projection approaches are used for segmentation.

3.2 Extraction

Key features of the characters are extracted from the characters using 16 segment display. By applying fixed threshold, 16 feature vectors are extracted which is used to distinguish a character from others. In the proposed work, multiple extraction approaches are used to extract features. Feature sets like number of endpoints, number of junctions, horizontal projection count etc. are calculated.

3.3 Identification

Classification is the decision making phase of character recognition where features gathered are used to identify the characters based on classification algorithms. The feature vectors obtained from input characters are compared with each representatives of the class labels. Nearest neighbor classifier is an example of one of the traditionally used classifier. In this work, neural network system is used for classification.

4 Classification Techniques

In classification input characters are compared using feature vectors with the representative of each character class. Each feature selection algorithm has its own advantages and disadvantages and choosing an appropriate feature selection method is one of the major challenges faced in character recognition. As a result, a classifier must have number of training patterns. There are many classification methods like template matching, kernel based method (SVM), ANN. Template Matching is the simplest of all the approaches in the pattern/character recognition. Here, the stored patterns/templates are compared with the prototype of the character. Support vector machine uses decision based learning algorithms for classification. This network finds a hyperplane with maximum margin space for n number of features in n-dimensional space. Hyperplanes divides the plane and the data points lying on the sides belongs to various classes. The support vectors are the data points which are nearer to the hyperplanes [9]. ANN is a wonderful tool used as a machine learning technique to deal with optical character recognition (OCR) related problems. Neural network (NN) uses several approaches to resolve OCR problems. NN is an information processing system which is based on the processing of human brain system. It uses trained artificial neurons in place of biological neurons. It consists of large number of interconnected nodes which are the artificial processing elements combined with weights. Like how human brain system adjusts to synaptic connections between the neurons, neural networks also need training. For this training algorithms are used. Machine is trained with set of input/output data and weights are adjusted using training algorithms. The purpose of adding link weight is to store the

knowledge required to solve the problem. Training algorithms give NN the ability to learn and adjust themselves in order to solve specific problems. Neural network approach can solve issues related to pattern recognition, clustering, time series prediction, function approximation. While dealing with data with simple patterns, methods like SVM can be used. But as patterns get more complex then neural networks play an important role. Deep neural networks make use of more than 2 layers of network in order to perform a task. CNN, RNN and LSTM's are powerful neural network approaches.

Every neuron in CNN is linked to an input and the size is equal to the size of the filter. In this approach, the number of connections between the neurons are limited. Input is convolved with filter which is trained and an activation function is applied to the output. The pooling layer reduces the spatial size. CNN's work well when dealing with sequences.

RNN can predict outputs based on time series. LSTM is an extension of RNN and enhances the performance by incorporating long term dependencies [10].

LSTM's have three sigmoid layers and outputs number zero and one for each number in the cell state [11]. The input gate has a sigmoid layer to decide which layer to be updated and the tanh layer builds new candidate values. The output gate generates output by applying a sigmoid layer resulting values between -1 and 1.

5 Proposed Method

In this paper, prediction accuracy of convolutional neural networks (CNN) is compared with CNN-LSTM architecture. The results are compared for their performance prediction accuracy. Proposed system is designed to train the network to recognize 5–15 letters in 16×16 pixel form. Training patterns are represented in a bipolar way. The image is converted to a vector of size 256 where letter pixels (foreground) are represented by 1s and background pixels are represented by 0s. For each input, network creates networks output to complete the training samples. Since we have 5–15 different, we can have a vector size 5 or 15. To this vector, bipolar values are stored, 0.5 for letters and -0.5 for others. Network is then trained with the training samples obtained by the network for all letters. For this a network structure to recognize 15 letters: 256 inputs stacked in input layer (equivalent to input vectors size), one layer of neural network, 15 neurons stacked in output layer (equivalent to output vectors size). At each learning node, samples from our training set are presented. Error rate is calculated. Training process is continued till error becomes less than a specified error limit. A convolutional neural network (CNN) takes input, assigns weight and biases, and able to recognize the character. It converts images to a form that is easier to process. A CNN model has: Input, Convolution, Pooling, Fully interconnected and Softmax.

Pixel-level input is directly fed to CNN. At a time only a portion of input image is processed at each convolution level. The output of each operation is fed to next level. Each convolution operation helps in extracting predominant features of the object.

Features thus obtained are gathered together to form the feature set. Pooling layer reduces the image size [12].

To obtain better results, CNN output is fed to recurrent neural network (RNN). Features extracted by CNN is given as input to RNN. RNN can recognize patterns and can process data sequentially. Memory of RNN lasts for short time periods and the problem with RNN is that it struggles with retaining information for longer periods. RNN architecture has restrictions at holding predictions in memory for long term [13]. Each network forwards the output to its successor. Since RNN doesn't remember the inputs after certain time steps, to overcome this challenge (for example, vanishing gradient and exploding gradient), the proposed system uses long term short-memory (LSTM) architecture approach. It is a distinct version of recurrent network, designed to retain information for longer time period that RNNs are not capable of. LSTM can learn over number of time steps and back propagate through layers. LSTM exhibits superior performance for character recognition as it deals with variations in horizontal and vertical axis using its two-dimensional architecture. LSTM is designed as a combination of two unidirectional networks. The equations given below are for unidirectional input gate calculation [14].

$$\delta_l^t = f'(a_l^t) \sum_{c=1}^{C} g(a_c^t)\varepsilon_s^t$$

The proposed system uses a hybrid architecture consisting of CNN and LSTM layers which are combined to recognize characters in a document [15] which is then fed to LSTM. This layer outputs a character matrix. CNN layers are created and output is returned. A convolutional feature maps for every layer. The output obtained is fed to RNN and to pooling layer (makes the representations smaller and more manageable). LSTM layers are created and output is returned—Create two layers of RNN, create deep bi-directional LSTM (an extension of RNN) for each layer, obtain outputs. Train neural network—Outputs a character probability matrix. CNN-LSTM architecture is depicted in Fig. 1.
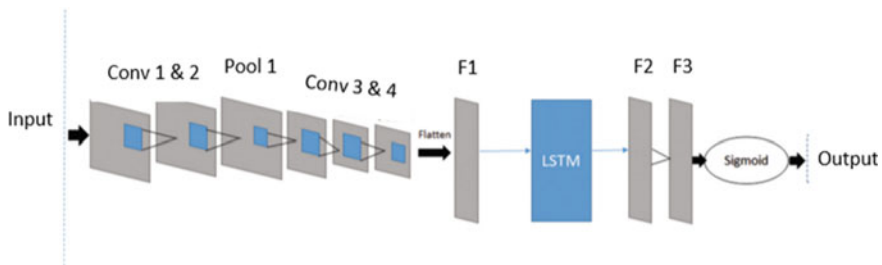
Fig. 1 CNN-LSTM architecture

Fig. 2 ROC curve: CNN-LSTM versus CNN
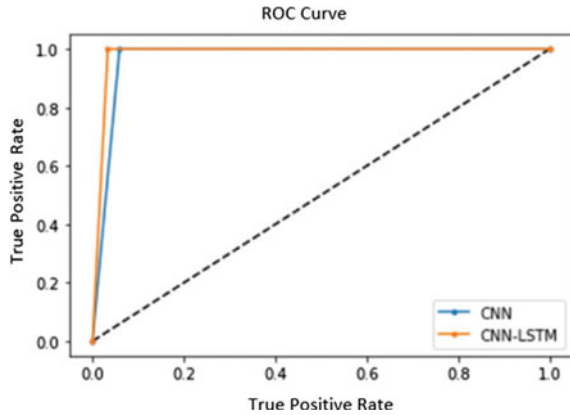
6 Experimental Results

Tools used for experiment: CNN, CNN-LSTM and image capturing for OCR neural network input data.

Results: Our network was successful at a mean of around 24,000 iterations. It was able to identify all letters correctly. Our network consists of 6 layers for CNN and 3 layers for LSTM. 6 neurons in the output layer (for 6 letters), 72 neurons in the input/hidden layers and approximately, had 16,000 connections and weights. Comparing the two methods. Results of CNN were passed on to LSTM to achieve better results (Table 1).

The precision results and loss of CNN and CNN-LSTM training network are shown in Table 2.

Table 2 shows the metrics for CNN-LSTM versus CNN and the improvements achieved by using the CNN-LSTM model. The results show that the CNN-LSTM model is more precise compared to the CNN-only with a loss of 0.32. The analysis

Table 1 CNN and LSTM configuration

Configuration		
Approaches	Layers	Types
Convolutional network	6	Convocational layers, pooling, flattening, hidden output
Long-term short-memory	3	LSTM, hidden, output

Table 2 Precision rate analysis

Comparative analysis		
Network	Precision rate (%)	Loss
CNN	92.79	0.30
CNN-LSTM	95.30	0.32

of the ROC curves for CNN and CNN-LSTM approaches reveal better precision rate for CNN-LSTM method (Fig. 2). The ROC curves show the trade-off between the true positive rate (4) and false positive rate (5) for a predictive model using different probability thresholds. The top left corner of the ROC curve plot is the ideal point (Fig. 2).

7 Conclusions and Future Work

In this study, we focused on comparing two neural network approaches CNN versus CNN-LSTM, in order to analyze their precision rate evaluation. For this purpose, we designed a network which was successful at a mean of around 24,000 iterations. It was able to identify all letters correctly. The proposed CNN-LSTM model had a better performance in terms of test accuracy (95.3%). We would like to extend the network to support more character set. This would involve increasing the number of hidden layers.

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A Computer Vision-Based Lane Detection Approach for an Autonomous Vehicle Using the Image Hough Transformation and the Edge Features

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Abstract Lane detection systems play a critical role in ensuring safe and secure driving by alerting the driver of lane departures. Lane detection may also save passengers' lives if they go off the road owing to driver distraction. The article presents a three-step approach for detecting lanes on high-speed video pictures in real-time and invariant lighting. The first phase involves doing appropriate prepossessing, such as noise reduction, RGB to grey-scale conversion, and binarizing the input picture. Then, a polygon area in front of the vehicle is picked as the zone of interest to accelerate processing. Finally, the edge detection technique is used to acquire the image's edges in the area of interest, and the Hough transform is used to identify lanes on both sides of the vehicle. The suggested approach was implemented using the IROADS database as a data source. The recommended method is effective in various daylight circumstances, including sunny, snowy, and rainy days, as well as inside tunnels. The proposed approach processes frame on average in 28 ms and have a detection accuracy of 96.78%, as shown by implementation results. This article aims to provide a simple technique for identifying road lines on high-speed video pictures utilizing the edge feature.

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1 Introduction

Each year, many accidents occur worldwide as a result of the expanding number of automobiles, resulting in significant financial and human losses [1]. Human error is the primary cause of many accidents, including weariness, sleepiness, lack of focus, and ignorance of road conditions [1]. Automobile manufacturers have made strenuous attempts in recent years to include driver assistance technologies into their vehicles to aid drivers in controlling and steering the vehicle [2]. Driver assistance technologies are becoming more prevalent as a means of boosting the security of premium automobiles [3]. Figure 1 shows the perception sensor location and corresponding ADAS function support for autonomous vehicles.

Some of the driver assistance systems include road diversion warning systems, accident warning systems, lane departure detection systems, junction and traffic light detection systems, and objects detection systems in front of the vehicle [4]. Among the planned driver aid systems, the lane detection system is critical for avoiding vehicle deviations and road accidents. Smart vehicles [2] are automobiles equipped with driving aid technology. The importance of road line detection in the realm of intelligent vehicles is substantial, since it has several applications in autonomous vehicles[2]. Intelligent automobiles receive data from road lines and direct the vehicle between them [3].

In recent years along with Autonomous Vehicles, computer vision has been introduced in several places, such as fraud detection [5], forensic system [6], home security systems [7], accident findings [8], IoT devices [9] and so on. The lane detection refers to the process of determining the limits of the lines in a picture of a road without
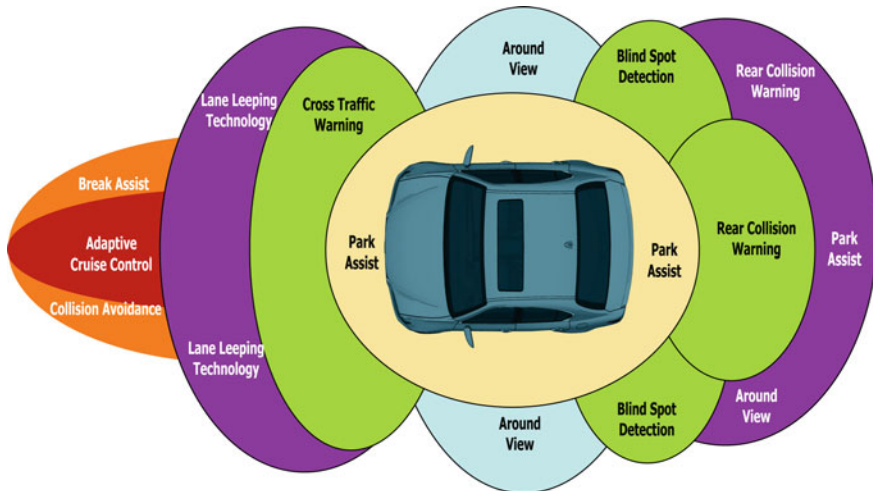
Fig. 1 Perception sensor location and corresponding ADAS function support for autonomous vehicles

knowledge of the road lines' locations [2]. The lane detecting system is meant to provide a prompt reaction and warning to the driver in the case a diversion from the primary path, allowing for increased vehicle control. Lane detection has been touted as a critical component of safe driving technology. By accurately recognizing the car's location and traveling within the road lines, this technology prevents the vehicle from diverting.

There are various methods for obtaining road lines in lane detecting systems. These include the placement of magnetic indications on highways, as well as the use of sensors, high-precision GPS, and image processing [10]. The most precise method of determining road lines is to place magnetic markers throughout the road that are detectable by automobile sensors [10]. Another method of determining a vehicle's present location is to calculate the worldwide change in position relative to road lines [10], which is also somewhat costly. The most accessible and cost-effective method of identifying road lines is by image processing, which extracts road lines from an image taken with a video camera [10]. Due to the fact that video pictures provide useful information about their surroundings [3], they are critical for lane detection. In-car cameras mounted behind the windshield are utilized in lane detecting systems.

For instance, Bertozzi [11] used the GOLD system, one of the most widely used lane detecting systems, which is based on road imagery through a camera mounted on a vehicle [3]. The path is determined using a method called model matching. Additionally, the car's front end is located via stereo image processing. The perspective impact of the picture is erased in this manner, allowing for the application of the pattern matching methodology [11]. The image's straight lines are then retrieved by employing a horizontal edge detector to look for horizontal patterns of dark-light-dark illumination. Then, pieces that are adjacent or have the same direction are blended to reduce the likelihood of inaccuracy due to noise or obstruction [12]. Finally, lines that correspond to a certain road model are chosen.

This experiment presented a computer vision-based approach for effectively distinguishing lanes in any surrounding environment. The first stage is necessary preprocessing, such as noise reduction, RGB to grey-scale conversion, and binarizing the input image. The region of interest will be selected as a polygon region to speed up the processing speed in front of the vehicle. Finally, applying the edge detection approach will help acquire the image's edges in the region of interest and the Hough transform to identify lanes on the input image. The remainder of the essay is divided into the following sections; we have discussed current existing similar algorithms in Sect. 2, and the method of the suggested lane-detecting approach is shown and explained in Sect. 3. The experimental findings and discussion are shown in Sect. 4 using input and output data. The paper comes to a conclusion with Sect. 5.

2   Related Works

In paper [13] authors apply the Hough transform and Euclidean distance in their investigation. To begin, the picture is converted from RGB to YCbCr space. Since

the human visual system is more sensitive to light, the Y component of the picture is employed to identify the lines. To increase the system's speed and accuracy, the bottom portion of the picture is chosen as the region of interest. Equalization of histograms is employed to improve the contrast between the road surface and the road lines in the region of interest, and an Otsu thresholding binary picture is created [13]. The area of interest is then split into two sub-areas, with the Canny edge detection and Hough transform techniques employed to independently identify the left and right lines of the road for each sub-region [13].

The author of [14] provides a technique for recognizing road lines that are robust to changes in illumination. This approach begins by extracting the image's edges using Canny edge detection, then obtaining the image's lines using the Hough transform and calculating the collision position of the discovered lines. The vanishing point is chosen to be the centre of the district with the most votes, and the region of interest is chosen to be the bottom area of the vanishing point in the picture. To ensure that the suggested method is robust to fluctuations in brightness, the road's yellow and white lines are calculated independently. The binary picture is then formed by assigning the binary value 1 to the regions next to the road lines and 0 to the remaining image areas. The areas of the lines are then noted, and the centres of each area are determined in the binary picture using the linked component clustering algorithm. Additionally, each region's angle and point of contact with the y-axis are determined. Areas with the same angle and junction are joined to make an area, and the picture denotes the left, and right lines of the road [14].

According to [15], the input picture is first taken out of perspective to align the road lines [15]. The colour picture is then transformed to greyscale, and the grey image's edges are retrieved using an edge recognition algorithm [9]. The morphological expansion operator is used to eliminate small picture noises. Then, using the Hough transform, the road lines are recognized and compared to the previous picture frame lines. Lines are maintained if they fit; otherwise, the following Hough transform lines are examined.

To ease the process of identifying lines, [16] has used a bird's eye perspective to capture the road picture in front of the automobile, which makes the road lines parallel. To identify the picture's edges, two one-dimensional Gaussian and Laplace filters are utilized [16], and the binary image is generated using the Otsu threshold and computed using the Hough transform of the image lines. Following that, the major road lines are created using a series of horizontal lines and their intersections with the picture lines are detected using the least mean square method [16].

The research [17] reported a robust Hough domain lane detecting system. The proposed approach employs road pictures to statistically calculate the predicted location and deviation of the road width. Additionally, a mask is built in the Hough domain to constrain the road width, and vehicle location as required [17].

The authors of [18] provided a novel strategy for preprocessing and identifying the region of interest in their research. The input frame is read first, and then the input picture is preprocessed; the area of interest is then picked, and the road lines are detected. Pre-processing involves converting the picture to HSV space and extracting the image's white characteristics. The picture is then smoothed, and the noise effect

is reduced using a Gaussian filter. Following that, the picture is transformed to binary using threshold processing. The region of interest is then determined to be the bottom half of the picture. The edge detection technique is used to extract the image's edges, and the Hough transform is used to identify the road's major lines. Finally, real-time detection and tracking of road lines are accomplished using the extended Kalman filter [18].

In [19] researchers developed a unique technique for lane recognition with a high degree of accuracy. The three-layer input picture is reduced to a single layer, and the sharpness is increased. The zone of interest in this research is determined by the lowest safe distance from the vehicle ahead. To provide a smooth lane fitting, the Hough Transform is utilized.

The paper [20] presents a multi-stage Hough space computation for a lane detecting challenge. A fast Hough Transform was devised to extract and categorize line segments from pictures. Kalman filtering was used to smooth the probabilistic Hough space between frames in order to minimize noise caused by occlusion, vehicle movement, and classification mistakes. The filtered probabilistic Hough space was used to filter out line segments with low probability values (threshold set to 0.7) and retain those with high probability values.

The paper [21] defined a Region of Interest (ROI) to ensure a dependable real-time system. The Hough Transform is used to extract boundary information and to identify the margins of road lane markers. Otsu's threshold is used to improve preprocessing results, compensate for illumination issues, and to gather gradient information. The suggested technique enables precise lane monitoring and gathers reliable vehicle orientation data in [21, 22] also mentioned this data in their research.

3   Methodology

This article uses video pictures obtained from the road by a camera positioned inside the automobile to determine road lines in real time. The camera is mounted inside the vehicle behind the windscreen and almost in the center to offer a view of the road.

The suggested approach for determining road lines involves three steps: pre-processing, area selection, and road line determination. Pre-processing steps include noise reduction, RGB to greyscale conversion, and input picture binarization. Then, a polygonal region in front of the automobile is picked as the area of interest due to the presence of road lines in that area. The third stage uses the Canny edge detection technique to identify the image's edges inside the region of interest, and the Hough transform to identify the road's major lines. Figure 2 depicts the block diagram of the proposed technique.

Fig. 2 Simplified block
diagram of proposed
technique
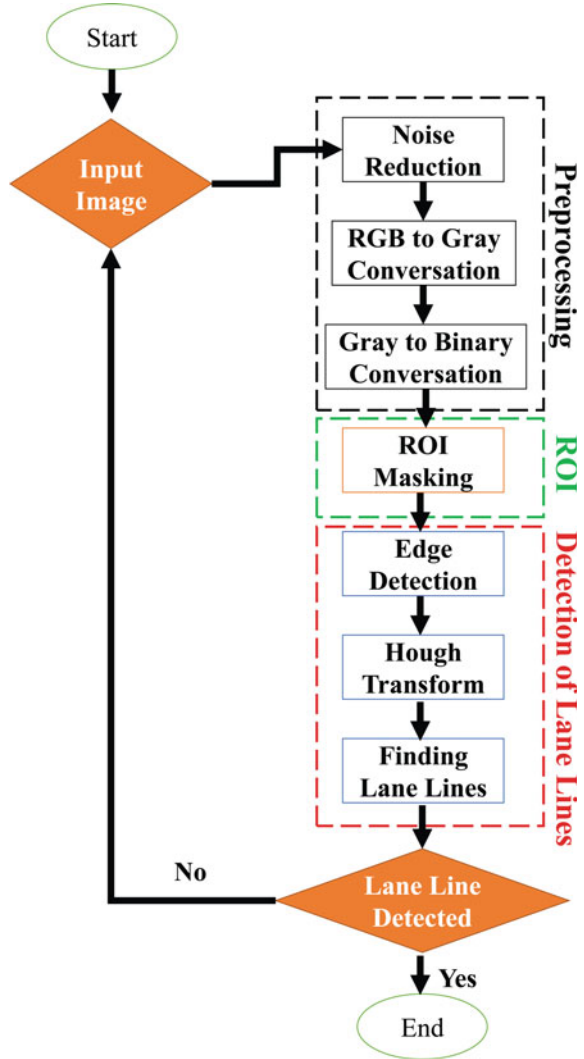
3.1 Preprocessing

The noise in the picture acquired by the camera positioned inside the automobile is
eliminated at this step using a Gaussian filter [23]. The output of Fig. 5 shows the
smooth image after the Gaussian filter [23] have applied in the input image Fig. 3
(Fig. 4).

Fig. 3 An example of the input image

Fig. 4 Input image after noise removing

Fig. 5 Input image converted into gray image

To minimize algorithm computations, the input picture is transformed to greyscale from RGB color space. In grey mode, Fig. 5 depicts the input picture. Then, using the Dong method [22], the input picture is converted from grey space Fig. 5 to binary space Fig. 6.

3.2 Region of Interest

The road lines are visible in front of and on both sides of the automobile in the photos received from the road surface. The region of interest in this article is a dynamic

Fig. 6 Gray image
converted into a binary
image

Fig. 7 An example of the
input image Mask to
determine the region of
interest

Fig. 8 Binary image after
applying the ROI mask
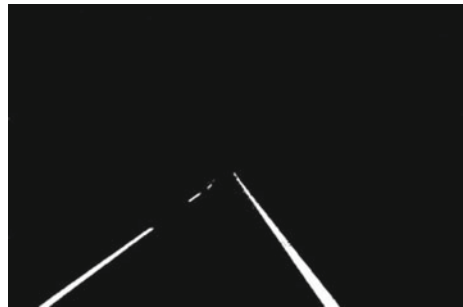
polygonal section of the picture in front of the automobile that was chosen using
a trapezoidal mask. The information about the image's vanishing point is utilized
to construct the trapezoidal mask. A trapezoid is formed in the bottom portion of
the vanishing point that encompasses the region directly in front of the automobile.
Figure 7 illustrates a mask created for the input picture sample in which the portion
of the image corresponding to the region of interest is one, and the remainder is zero.
By applying this mask to the input binary picture, the preferred region is picked,
containing the road lines just in front of the automobile. The output binary picture
in Fig. 8 results from applying the designed mask to the input binary image.

3.3 Determination of Road Lines

The usage of picture edges is a very helpful and effective feature for detecting things in photographs. The image's edge is the point at which the brightness abruptly shifts. As long as the quantity of light on the road is consistent and differs from the brightness of the lines, the border between the lines and the road (edge) may be determined. Numerous algorithms are available in this sector, including those developed by Sobel, Canny, Roberts, and Prewitt. The Canny edge detection technique is used in this article [24]. Six steps are required to identify the edge using the Canny edge detection technique. The first step is to filter out the noise in the original picture, which is accomplished using a Gaussian filter [23] and a basic mask. The second stage is to locate strong edges at any location by using the gradient amplitude. Two masks are applied to the picture for this purpose, the gradient amplitude in the x and y directions is computed, and the edge strength is determined using (1).

$$G = G_x + G_y \tag{1}$$

where G represents the edge strength, G_x represents the gradient amplitude in the x direction, and G_y represents the gradient amplitude in the y direction in (2).

$$G_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix}, G_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} \tag{2}$$

The third stage establishes the orientation of the picture edges generated via the use of Canny masks (3).

$$\theta = \arctan(\frac{G_y}{G_x}) \tag{3}$$

where θ denotes the edge direction, G_x denotes the gradient along the x axis, and G_y denotes the gradient along the y axis.

The fourth step matches the directions determined in the previous step to one of four angles of 0, 45, 90, or 135 °C. The fifth step is to suppress non-maximum edges by checking the direction and removing those that cannot be recognized. In the sixth stage, the Canny algorithm is utilized with the hysteresis approach, which defines two higher and lower threshold values. Any pixel with a gradient larger than or equal to the lower threshold is allowed, whereas any pixel with a gradient less than or equal to the lower threshold is rejected. We extract the picture's edges by using the Canny edge detection algorithm [24] to the binary image. The outcome of applying the edge finder algorithm on the previous stage picture is seen in Fig. 9.

The Hough transform is used to identify the major lines of the road in the following. Hough transform is a method for extracting features from digital images that is used in digital image processing, machine vision, and image analysis. The objective of this conversion is to discover the many forms included inside the picture. Initially,

Fig. 9 Apply the Canny algorithm into the binary image

Fig. 10 Simplified output of the input image

the Hough transform was used to recognize visual lines, but it was later extended to identify diverse forms such as circles and ovals. The Hough transform is employed in this technique to determine and indicate the locations of road lines. Then, as illustrated in Fig. 10, the nearest lines on both sides to the automobile are deemed road lines on the left and right.

4   Results and Discussions

The IROADS database [25, 26] is used to evaluate the performance of the proposed algorithm. The database consists of 7 collections with a total of 4700 image strings. It covers almost all possible road conditions, including daylight, night darkness, excessive sunlight, tunnel light, day and night rainfall, and snowy roads. The dimension of each frame in this database is 360×640. Given that this paper examines the different lighting conditions per day, four sets of data from the IROADS database, including daytime driving in sunny, rainy, snowy, and in-tunnel conditions, are reviewed. The average detection rate for 2828 frames from the IROADS database in various daylight circumstances is 96.78%, as shown in Table 1.

Figure 11 illustrates the results of the proposed algorithm's road line identification in various driving circumstances throughout the day.

The suggested method produces the following two modes of operation on each frame of the input picture.

Table 1 Accuracy of the proposed method under different weather conditions

IROAD database	Total number of frames	Number of incorrect detection frames	Identification rate (%)	Number of frames per second
IROAD daylight	903	32	96.40	35.2
IROAD rainy day	1049	7	99.38	35.6
IROAD snow day	569	31	94.59	36.2
IROAD tunnel	307	21	93.12	35.8
Total	2828	91	96.78	35.7
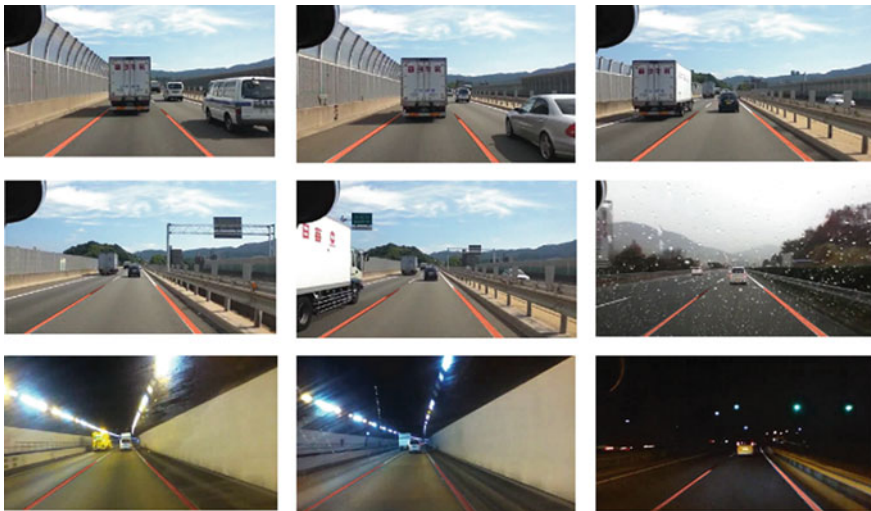
Fig. 11 Output of proposed technique in different environmental scenarios

1. Accurate detection, in which the lines on both sides of the vehicle are appropriately detected.
2. Incorrect detection, in which the lines on both sides of the automobile or on just one side are not accurately recognised. The suggested algorithm's recognition rate is determined on the labels created before utilizing.

$$\text{Detection Rate} = \frac{\text{Number of identified frames}}{\text{Total number of frames}} \times 100 \tag{4}$$

The suggested approach is implemented in Python on a laptop with a 2.40 GHz CPU and 8 GB RAM, and it takes an average of 28 ms to analyze each frame. As a result, the suggested method accurately recognizes road lines in a timely manner. To evaluate the suggested algorithm's performance, it was compared to many methods already published. Table 2 compares the findings obtained using Kortli's approach

Table 2 Comparative result analyses of the proposed method with some existing techniques

Methods	IROAD day light	IROAD rainy day	IROAD snow day	IROAD tunnel	Total
Kortli's method [14]	95.79	88.27	86.64	93.51	90.81
Suto's method [27]	96.12	93.42	92.44	94.14	94.17
Tian's method [28]	96.23	94.75	93.67	94.46	94.99
The proposed method	96.40	99.38	94.59	93.12	96.78

[14], Suto's method [27], Tian's method [28], and this study's method using the IROADS dataset [26]. According to the findings of this experiment, the suggested technique outperforms the current method in every category except the Tunnel scenario. This is mostly due to the fact that the line indicators are muted in this case owing to the tunnel lights and hence are not recognized for the suggested technique. However, if earlier frames' data is utilised, the outcomes may be enhanced.

The findings demonstrate the suggested algorithm's usefulness in identifying lanes under a variety of scenarios. The suggested approach does not yet include tracking, since lanes are detected individually in each picture without the use of temporal information. Although the suggested method for recognizing road lines works well in 97% of situations, it may fail in 3% of circumstances due to road lines fading, side vehicle covering of road lines, and driver direction shift.

5 Conclusions

Lane detection refers to the process of determining the position of lane borders in a road picture without having previous information about their location. Lane detection is intended to notify the driver about departures from the main lane, allowing for improved vehicle control on the road. The purpose of this article is to provide a simple approach for identifying road lines on high-speed video pictures by using the edge feature. The suggested technique begins with the required pre-processing, which includes noise reduction, picture conversion to greyscale, and finally binary mode. The ideal region was then found to be a polygonal area just in front of the vehicle. Finally, the Canny edge detection technique and Hough transform were used to identify road lines.

The suggested algorithm's performance was evaluated using the IROADS database, with each frame having a size of 360×640. The research examines four datasets from the IROADS database, including daylight driving in sunny, wet, and snowy circumstances, as well as indoor tunnels. The suggested technique executes on average in 28 ms per frame and achieves a detection rate of 96.78%.

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Internet of Things (IoTs) in the Hospitality Sector: Challenges and Opportunities

Salifu Shani, Mohammed Majeed, Seidu Alhassan, and Awini Gideon

Abstract This research examines and evaluates IoT applications in the hotel industry by looking at several sectors and evaluating the benefits (opportunities) and drawbacks (challenges) of using IoT. The hotel industry will experience tremendous growth because to the Internet of Things, which offers a wide range of characteristics that can be used to tailor service. Future corporate procedures will focus on increasing productivity while reducing turnaround times. Integrating it will be necessary to preserve a competitive advantage because it will change standards and the landscape of services.

Keywords Internet of things · IoTs · Hospitality · Challenges · Opportunities

1 Introduction

The hospitality business has a long history of being slow to absorb new technological innovations. Nonetheless, the industry's breakthroughs in social, local, and smart marketing have been prompted by rising visitor demand for online engagements using digital touchpoints [1] By 2020, the number of installed IoT devices is estimated to reach around 25 billion, with manufacturing accounting for the majority of this development. The overall information technology (IT) issue is that, as a result of the usage of IoT devices in their settings, certain hotel services are witnessing an increase in security breaches. When it comes to hospitality, service digitization is all about making services available to guests at their fingertips [2, 3]. To ensure that visitors' vacations are as easy as possible, an online service platform enables them to explore and schedule activities at their own pace [4]. Digital services that include social network features, as well as those that include booking and reservation

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services, location-based services, and customized communication, are some examples of the kinds of services that appeal to visitors who are tech-savvy. As a result of the hospitality industry's recent technology improvement, visitors and hostel service providers may work together to create a mutually advantageous platform for both parties (HSP). The platform's goal is to improve HSP's operational and administrative efficiency while also providing visitors with a great experience. Destinations must adapt to technological advances since the criteria for retaining competitiveness change on a regular basis. Beyond the 6As of successful destinations, the 6As should be defined around interaction and real-time data rather than the attractions, accessibility, amenities, availability, activities, and ancillaries. Building on the many kinds of destination management already in place, the production of value entails making experiences physically available in order to develop and place knowledge. It is necessary to have a conceptual framework for the components of a successful hospitality establishment. In this sense, the quality of the information, the authenticity of the sources, the interactivity, and the accessibility of the data are all key components of smart data. Users may be assisted in making travel choices by means of a framework that can be developed, with the emphasis being placed on self-efficacy rather than on destination managers or hospitality firms. The fact that the type of the data generated has an effect on the ways in which people interact and consume in a place contributes to the value of the data.

Businesses, managers, planners, residents, and visitors are all increasingly relying on web access and smart mobile devices. Knowing how and when to send (and compute) data is crucial for the transmission of information through appropriate communication channels, even if numerous platforms exchange and communicate data. Large amounts of data are required in order to arrive at useful conclusions for the general public, hence hospitality IoT adoption must be included into a company's overall development and progress. Furthermore, digital connectivity can assist a destination in locating visitors and positioning them in their new surroundings, allowing it to focus information at them [5]. The Internet of Things is open and relational in the sense that it connects or links various human and nonhuman objects, as well as datasets—relational theorists believe that entities are unimportant in and of themselves because what matters most to them is the relational data between the entities, not the entities themselves [6] give a narrative that details cybersecurity risks in the IoT, but the article lacks practical techniques for securing IoT implementation challenges. There are previous research that may serve as precedents for the one that is being presented here as in [7] but have substantial differences in terms of challenges and opportunities. Most studies focused on only the security and privacy challenges without telling what the future holds for hotels that adopt IoTs.

Notwithstanding these hurdles, IoT is rapidly becoming an essential focus of successful business practices in all sectors, from agriculture to manufacturing, and hospitality is no exception. IoT integration is essential to enhancing customer happiness, gaining a competitive edge, and enhancing operational efficiency. Because of this, I concluded that a comprehensive investigation, including some technical elements, was essential to bring this expanding issue to the attention of practitioners and researchers in the hospitality industry. Because there is still a lack of awareness

of the issues and possibilities presented by IoTs in hospitality, this chapter aims to fill it. This chapter provides a logical overview of concerns that will make it possible for buyers to share and experiential guest opportunities depending on the IoT system for hospitality. To better understand this, we will look at key literature on IoT for hotels.

This research gives a complete review of hospitality-related IoT research and applications. It aids in gaining a clearer picture of current events and future possibilities. Instead, then concentrating on a specific sector, a holistic approach was employed, allowing all parts of the subject to be considered. In addition to technical features, obstacles, and concerns, the reader will find theoretical support here as well.

The rest of the chapter discusses literature review comprising of the definition and concept of IoTs, enabling technologies for IoT, opportunities of IoTs, challenges of IoTs, IoT application in the hospitality industry, IoT market drivers, and impact of IoT in marketing. The final section deals with conclusion and future research areas.

2　Methodology

The usage of IoT in hospitality is demonstrated in this chapter using prior works and exemplars. Searching for relevant terms is done using academic indexing services like Google Scholar, WoS, Scopus, and ScienceDirect. To gather information, whitepapers, service provider IoT project websites, and media coverage are used. The investigation of related work is done by categorizing it into primary hospitality categories.

3　Literature

IoTs

An IoT is a network of interconnected devices containing sensors, actuators, and processors that can communicate with one another to accomplish a certain task. Internet infrastructure that links (physical and virtual) objects, enabling better services based on existing and future compatible information technology. Devices that are linked to the internet through sensors perform functions and communicate real-time data as part of the Internet of Things (IoT).

4　Applications of IoT

A wide range of real-time data about the urban environment is made available to residents and businesses alike via the use of sensors, networking structures, and

Cloud-based integration systems by businesses in order to provide inhabitants with services and infrastructure.

In order to provide an economically efficient, sustainable power system with minimal losses and high levels of supply quality, security, and safety, smart grids are energy networks that can cost-effectively integrate the behaviour and activities of all users attached to them.

The collecting, consolidation, and efficient processing and mining of huge volumes of data pertaining to physical and mental health is known as "Connected Health".

Homes that can be controlled remotely from anywhere with an internet connection via a smartphone or other networked device are known as "smart homes," and they are becoming more popular.

Vehicles that can connect to the internet and communicate data (such as location, speed, and the condition of different automotive components) with back-end applications are referred to as "connected automobiles". A variety of processes, such as booking a service with a vehicle service provider, may be developed as a consequence. In the event of a potential accident, connected automobiles may communicate with each other and provide warnings to each other.

Three types of IoT applications can be classified based on their primary requirements:

1. Real-time applications are those that have a time limit. Real-time monitoring of vital signs is required not just for connected health and smart farming, but also for effective commerce through the Smart Supply Chain. For example, connected health and smart farming both need real-time monitoring of vital signs.
2. Applications whose primary emphasis is data analysis are referred to as "data analysis". For instance, data analysis is used in Smart Retail, Smart Cities, and Smart Grids, respectively, to improve business, cities, and electrical grids.
3. Interactions between devices are the primary focus of apps, which place an emphasis on these connections. Interaction between different types of devices is a primary focus of the Smart Home, Wearables, and Industrial Internet movements.

5   Enabling Technologies for IoT

ICT developments in computer networks, embedded systems, and artificial intelligence have made it possible to achieve the objective of a Smart Home, at least in theory. A variety of artificial intelligence may be shown in smart home settings by adding extra smart features to the home automation systems that already exist. With the help of home networking, "smart home" technology brings together a variety of devices and services to improve the quality of life for the residents of a house. Some of the enabling technologies for the Internet of Things (IoTs) include RFID, IP, EPC, Barcode, Wi-Fi, Bluetooth, ZigBee, NFC, Actuators, Wireless Sensor Networks (WSN), and AI (Fig. 1).
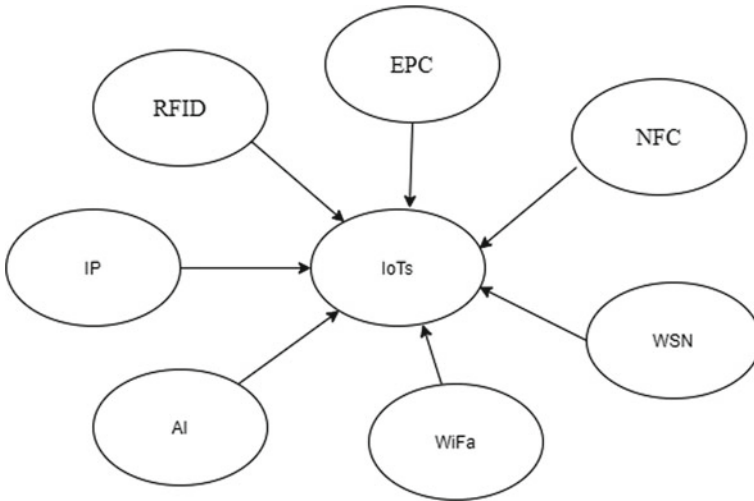
Fig. 1 Enabling technologies for IoT

6   Opportunities of IoTs

As the Internet of Things (IoT) advances, it is reshaping the future of hotel management. There are a variety of options for hotels thanks to IoT and other technology.

Businesses in the hotel industry will profit from IoT by letting guests know where they are, what they have to offer, and how popular they are (based on user-generated content provided by previous clients). The Internet of Things (IoT) has the potential to assist businesses that are only known locally expand their market share and bring in new customers. For example, if the client's needs are met satisfactorily, the small local firm will be able to build a long-term online reputation from each customer, even if they only come once. Increasing competition in local markets for high-quality goods and services may encourage businesses to keep quality at a fair price. Tourists need a greener and safer environment in order to boost the economy. A significant part of a place's identity, as well as a source of attraction, is the preservation of its natural and cultural history [8].

Considering Gartner's prediction that 26 billion IoT-connected devices would be in use by 2020, all major tourist and hospitality corporations have come to appreciate the significance of technology and the tremendous potential it presents for contemporary businesses. Technology like IoT, Big Data, AI, and cloud computing are all being used in the hotel and tourist industry to improve the customer experience, industrial growth, and administrative control. It is no secret that the tourism industry has a reputation for being slow to accept new technologies, but this has not deterred them from exploring new innovations like the Internet of Things (IoT). In addition, it might assist to simplify the daily operations of a hotel or travel agency [9]

In order to increase profitability, preserve growth, and acquire a competitive edge, hoteliers are continuously seeking to enhance their value chain [10], recommend that company owners include an IoT strategy into their business processes in order to boost their margins and remain competitive in today's global economy. The adoption of IoT to create value throughout a company' chain of activities was noticed by [11] IoT tactics across the supply chain might boost profit by cutting costs or distinguishing goods. From the standpoint of a hotelier whose main purpose is to offer a unique guest experience while also maximizing income, using IoT methods might improve customer loyalty and so provide a competitive edge.

Boost productivity: Because of the Internet of Things, physicians will be able to get a fuller picture of their patients' health than they could previously get at the doctor's office. By offloading some of the more tedious tasks that occur in healthcare, resources will be freed up. It is possible for doctors to spend more time with their patients because of the time saved.

Indirectly, the Internet of Things can aid tourism by monitoring environmental health issues such as pollution levels. The capacity to market locations and encourage visits has long been increased by the internet, with all destinations now having an online presence. Tourists, on the other hand, require quick, accurate, and trustworthy information in an increasingly competitive tourism sector. Because destination managers and planners have similar information demands, this necessitates co-creation [12]. Smart IoT tourism systems interact with visitors, allowing them to engage and absorb information in a group setting [13]. Geographically informed concentrations can establish hotspots or channels to attract customers, guided by local knowledge and business methods. Users then reinforce and promote user-generated and/or user-guided insights and interests, detracting from more traditional types of marketing and destination planning [14].

7 Digital Transformation

The Internet of Things is a significant technical development that is assisting industrial processes in becoming more adaptable, human-centered, inventive, consumers, streamlined, and efficient (IoT). End-to-end customer service optimization, operational flexibility, and innovation, as well as the emergence of new revenue streams and content ecosystems of value, are significant drivers of digitalization that contribute to business model changes. Through glance-able marketing, marketers can present pertinent adverts on wearable technology. Communications must be succinct, clear, and laser-focused because the quantity of marketing available area will be much less, even when comparison to marketing on a mobile device. The goal of this advertising strategy, known as glimpse marketing, is to produce content that can be consumed in under two seconds. Wearable technology might soon provide location-based marketing, enabling contextual marketing.

Companies will provide details about each target customer's routine, preferences, purchasing trends, and general behaviour through ubiquitous marketing. A veritable

data gold mine results when this info is joined with information from other sources, such online networking profiles or internet purchases. Theoretically, messages could be delivered to clients practically everywhere, at any times, and via any media with a display if there were enough equipment to cover the entire city. For instance, data can show that a customer stops outside a clothing company but doesn't go inside. Using the software, the same person may be recognized, and advertisements for similar or comparable product may then be aimed to appear on their laptop when they are best likely to make a purchase.

The Iot also enables HSP to embrace cost-saving strategies like smart energy management and boost the back-end effectiveness of numerous departments (including the front desks, housekeeping, sales, and marketing, for example) [15]. Future Internet of things, such as wireless body sensor sensing devices and monitoring, will undoubtedly open up new economic opportunities in the hotel industry [2], and Internet of things has already started to spread thanks to public terminal and in-room technologies now in use. HSPs should therefore work to make their technology design future-proof so that their systems can be swiftly modified as the IoT ecosystem changes [7]. Customer preference is another chance. In the industrial setting, IoT provides end-to-end optimization, digitization, and transparency in addition to better client services. It is crucial to use customer insights obtained from an integrated manufacturing method to enhance products, quality, and services. Through IoT, the manufacturing process may be effectively incorporated with the supply chain, services, and transportation, enabling the production process to be changed in real-time in response to customer insights. The quality of the product may be enhanced based on the opinions of the customer. IoT could be used by manufacturers to implement a marketing concept rather than a drive technique, which is an essential part of the lean toolset. By using this technique, producers may cut back on excess inventory while still meeting customer standards for quality.

Continuous product improvement: Companies should pursue continuous improvement by fostering an innovative, accessible, cooperative, and customer-focused culture. IoT products should adopt an agile and dev-ops method instead of a waterfall model for product development, in which multiple teams within the company collaborate to improve the product. A high-quality product must be guaranteed from the beginning of the cycle. If quality erosion is found, development must be done in brief sprints with pre-planned iterations. Even after the product has been made available to users, it may still be improved by looking at the sensors and software attached to real items. The information provided aids the product development team in assessing user perceptions of the product, popular features, and unusual use cases. Then, with IoT, products can be enhanced. IoT puts a priority on customer feedback: The intelligent design of Internet of Things (IoT) products must be sophisticated, useful, easy to understand, and creative. All employees of the organization's teams, from developers to marketing professionals, designers to product marketers, must understand the essential importance of the customer and product experience in order to build a high-quality product that delivers both experiences. The selection of features and the creation of the product roadmap both heavily rely on customer feedback. Marketers

need to express the customer's perspective to all organizational levels before introducing a product. To get customer feedback, a variety of approaches are employed, including surveys, focus groups, questionnaires, and primary market research (PMR). Customer feedback can be utilized to enhance the product and remove obstacles for customers. The product team must work closely with the client in order to validate and develop the concepts. IoT develops your presence, to finish. Establishing the brand's presence at the proper IoT events occurring all over the world is crucial for a marketer. The number of conferences, forums, forums, seminars, and other gatherings focused on the Internet of Things is growing.

8   Challenges of IoTs

For at least a decade, IoT devices with limited capability have been available. There are certain security flaws in the internet of things that have been identified in the literature that are unique [16].

1. **Significant upfront investment**: Acquiring new functional skills requires a significant upfront expenditure. Businesses must modify their operations, account management, program management, sales, and product management procedures in order to deliver the proactive services necessary to maintain their competitiveness in the IoT market.
2. **Energy-optimization**: A fundamental limitation for resource-constrained IoT devices is reducing the amount of energy consumed for communication and compute. Every day, the demand for solutions that aim to reduce energy use becomes more pressing. To reduce energy consumption not only during regular operation but also during DoS assaults [38], careful protocol (re)design and usage are essential.
3. **Self-configuration and self-organization**: Because of the intricacy and sheer dynamism of IoT systems, it is imperative that the intelligence of the system be decentralized and that IoT devices, or at least a portion of them, be given the ability to respond independently to significant events. Things should be able to execute device and service discovery in addition to tweaking protocol behaviour to adapt to the present challenging environment in order to maintain robust network performance with little human involvement. This is necessary in order to keep the network functioning properly.
4. **Scalability**: IoT systems have to be able to support a growing number of connected devices, users, and analytics capabilities while yet maintaining a high degree of QoS since there are so many different kinds of devices. However, scalability issues occur when it comes to data transmission and networking, service provisioning and administration, as well as device name and addressing. This makes the process difficult to finish.—Security—Internet of Things devices that have a restricted number of resources are more susceptible to attacks and threats. On the other hand, Internet of Things (IoT) networks should be secure

and protect users' privacy while yet maintaining their usefulness despite the significant entanglements they have with the physical environment.

5. **Semantic interoperability**: The Internet of Things calls for the transfer and examination of significant volumes of data on a regular basis. A semantic description and the availability of data in specified formats are essential for the effective deployment of IoT. This is necessary in order to transform the data into information of value and enable interoperability across various applications. It is essential that information be shared across all of the linked Internet of Things devices. However, since there are so many different kinds of technology and devices on the market, interoperability has become an extremely pressing issue.

6. **The rapid increase in the number of IoT devices**: IoT has been a favorite target for cybercriminals because to its widespread adoption and pervasiveness [17]. Legacy systems that were not previously linked to the internet and were not constructed with data security in mind are being integrated with IoT solutions [18]. End-to-end communication in IoT prohibits fundamental security solutions such as encryption from being implemented. [19, 20].

7. **Concerns about security**: As gadgets become more and more connected, privacy and security are becoming increasingly threatened. There are worries about hackers taking our data and possibly putting our lives in danger, as well as about businesses utilizing our personal information for their own gain. A system that is frequently used by users will be targeted by hackers who want to create extensive disruption. Consumers now have to care about spyware attacks not only on private computers and other devices, but also on various small household appliances or gadgets that are connected to the Internet and could be compromised.

8. **Information Security**: The limited compute, storage, and network resources that are accessible to IoT devices and apps are a contributing factor in this phenomenon. Because Internet of Things devices are often deployed on low-power, lossy networks that have limited resources, it is impractical to implement conventional network security measures such as those pertaining to energy, computing power, and memory capacity [21]. IoT devices do not have the computing power to enable the implementation of complicated security strategies; as a result, these strategies cannot be used [22].

9. **Lack of Standards**: Despite the fact that the IoT market can provide the maximum value when it is associated with a wide variety of devices and services, it is now relatively fragmented and has few or no standards. Only 13% of firms offer Solutions that integrate with products and services from third parties, according to recent Capgemini report. The enemy of the IoT is fragmentation because it inhibits devices from connecting with and instils in customers a fear of just being locked in. One of the main causes of fragmentation is the abundance of tools and techniques available to reap the rewards of linked devices. Due to fragmentation, businesses are unable to provide an ecosystem of goods and services.

9 IoT Application in the Hospitality Industry

The Internet of Things is being put to use in a variety of different ways to boost productivity and provide superior customer service. As a result of the proliferation of smart homes, hoteliers are now in a position to better serve their customers, provide services that add more value, and operate their establishment more effectively than ever before. The rise of smart gadgets and the Internet of Things (IOT) is having a transformative effect on the hotel industry's technological landscape [23]. The Internet of Things (IoT) technology can be used in the hospitality industry to provide integrated services such as automated door locks, set-top boxes, thermostats, telephones, light switches, voice-based interaction, electric blinds, and other devices that are connected on a shared network to meet the needs of hotel guests. These integrated services are in response to the growing demand for these types of amenities among hotel guests. Both the hotelier's and the guest's experience will be improved with the addition of these features. As a result, hotels will be able to offer their visitors more value while saving money. In the hospitality industry, hotels depend heavily on technological tools since their customers need more technology to keep up with their hectic schedules and to imitate the feel of home. In the hospitality industry, IoT adoption is perfectly positioned to handle a wide range of concerns and provide new services. Automation and tailored services are the first to be offered in smart rooms. At many hotels, self-check-in is becoming the norm, thanks to the help of a smart lock. Bluetooth smart locks can be unlocked with a smartphone app, but they cannot be controlled remotely. Using a smart tablet and a smart room that supports Z-wave or Zigbee, you can control anything from the TV to the curtains to the temperature to your phone and even your coffee maker.

10 IoT Market Drivers

Below are the few enablers behind its growth.

1. **The cost of sensors and actuators is decreasing**: A networked gadget needs sensors to interface with the outside world and to keep track of its surroundings. They work as a digital nervous system that gathers information about position using GPS sensors, visual and acoustic information using cameras and microphones, and environmental information using sensors. The cost of sensors has decreased by 50% over the past 10 years and is steadily declining, making it simpler to integrate them with physical equipment.
2. **Increased investment in IoT**: Companies like Google, Samsung, and Dell have made large investments in their IoT departments and are still conducting research and development. Acquisitions like Google's purchase of Nest, Intel's purchase of Basis, Microsoft's purchase of Solar, and Qualcomm's purchase of

NXP are further examples. The most sought-after acquisition targets are businesses with key competencies in data analytics, cyber security, cloud computing, semiconductor chip fabrication, connectivity platform capabilities, and services.

3. **Increasing Internet Connectivity**: Studies show that 40% of the world's population currently uses the internet, and that number will increase to 57% by 2019. IoT devices will be more in demand as they become easier to access, sparking increased interest in buying IoT hardware.

4. **Smartphones, phablets, and tablets are in high demand**: These tools are used by end users to manage and operate IoT equipment. Currently, smartphones make about 70% of all mobile phones, and their share is Studies show that 40 percent of the world's people are currently

5. **Wireless technology innovation**: Applications and objects that weren't previously connected are now connected thanks to the Internet of Things (IoT). A variety of hardware devices are being connected thanks to low-power technologies like LPWAN (low-power wide-area network), Zigbee, ZLE, and BLE as well as high-speed mobile communication protocols like LTE, 4G, and 5G. Peer-to-peer protocols that enable direct device-to-device connections, like All Seen, DLNA, and UPnP, are also gaining popularity.

6. **Analytics**: Thanks to advances in server processing power, the accessibility of cloud infrastructure with limitless storage and computational capacity, and better interface and visualization techniques, the market for big data analytics has exploded recently. Businesses invest a lot of money in gathering insights and making proactive data-driven decisions in order to obtain a competitive advantage.

7. **Business Model Shift**: With the help of IoT, products are now services. IoT enables users to pay for services rather than stuff, enabling pay-as-you-go usage of the product. Subscription-based services are increasingly being used by more people. Services for business printers are an illustration. Instead of purchasing printers, toner, paper, and maintenance, businesses are increasingly subscribing to usage-based printing services.

11 Impact of IoT in Marketing

The Internet of Things will have an impact on marketing in the following ways:

1. **Consumer Behavior**: By 2020, the globe is expected to have 50 billion connected devices, and marketers will be able to see what consumers are doing, when and where they are buying, thanks to advances in big data analytics.

2. **Improved Personalization**: Customers will be able to interact with marketers in "real time," receiving more relevant advertisements. A marketer may now be able to determine from a number of precise indoor location technology solutions if a customer has been lingering close to a product for an extended period of time without making a purchase. The marketer can send a promotional message to the customer's smartphone to aid in decision-making.

3. **Instant Customer Analysis**: Companies that offer IoT platforms to clients, like Smart Home Kit, can gather data from various devices to ascertain the lateral needs, preferences, and behaviour of the user. It will support the growth and marketing of cross- and lateral-selling opportunities.

4. **Predictive social media**: Social networks built on networking websites like Facebook, Linkedin, and others can be used by IoT. Businesses can connect with potential customers who may not have previously been engaged by using the automatic posting and sharing capabilities of IoT devices. These more focused initiatives will help marketers spot and take advantage of fresh emerging trends. By delivering warnings when normal maintenance is required, Toyota's Friend platform, for instance, enables car owners to engage with their vehicles, dealerships, and Toyota directly. Additionally, it links to social networks, enabling you to speak with loved ones (Toyoda, n.d.).

5. **Customer Input**: With the help of the Internet of Things, marketers can quickly get input from customers in a number of ways. As a result, marketers will be able to measure this data much sooner and take remedial action to reduce their losses if a specific product isn't doing well enough in the eyes of customers.

6. **Product as a service**: A product is really a tool used to provide customers with a service, and companies are rapidly shifting their emphasis from products to services. As a result of the Internet of Things, hard-core OEMs are now positioning themselves as technological service providers. Integration of products and services is not a new concept, but it has become more simpler thanks to the Internet of Things. Here are a few instances of how companies are making use of the potential of connected devices to create value.

7. **Automation**: Automation is the ability to complete a task without requiring any kind of human involvement. The five theories of operation management support it because it eliminates errors, makes the workplace safer, expedites work and lowers costs [24, 25]. The hospitality sector can benefit greatly from automation, including self-check-in and temperature management using Internet of Things (IoT) devices like smart locks and thermostats. These advantages include a decrease in waste and inefficiencies as well as an improvement in operations that lessen consumer discontent brought on by superfluous or inefficient actions [26, 27].

12   Conclusion

IoT has produced a multitude of applications that impact every part of human existence by linking billions of items to the Internet. Hotel monitoring, safety control, and fault detection are examples of time-sensitive, mission-critical services that require reliable connectivity and rigorous dependability limits. IoT, on the other hand, is mostly based on Low-power Lossy Networks (LLN), which are inherently unreliable because to their limited resources, harsh duty cycles, unpredictable topologies, and unreliable radio connectivity. Because LLN faults are more common than

uncommon, maintaining continuous device availability and communication reliability are key considerations in ensuring a consistent, dependable flow of application data.

A hassle-free journey for each and every tourist requires avoiding unanticipated problems and disappointments wherever possible. This may be accomplished by being aware of the exact instructions to take or the calm hours at an attraction. Travel has already started to become more personalized and easier thanks to apps built for the internet of things. IoT-based services may assist travelers in making more informed choices by delivering information that is more relevant to their needs, as well as information that is intelligent and customized. Consumer-generated content and implicit feedback provided by IoT may assist local companies compete for a greater portion of the market and learn how to enhance their service quality based on IoT-generated content and consumer-generated content. This can help strengthen the local economy. This might help the local economy catch up with the overall trend of the country's economy. Tourism providers, managers, and planners will benefit from the internet of things in the future if the technologies now in place are properly integrated. This means better connecting guests based on local knowledge and useful promotional content.

13 Future Research

When future technologies such as 5G and blockchain are combined with IoT, there is the possibility that new ideas will be inspired and given the ability to be implemented. The deployment of 5G will enhance connection by resolving difficulties with latency and bandwidth. Additionally, it will bring about the introduction of new smart gadgets, which will lead to a rise in the usage of digital applications in the hotel industry.

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Content-Based Spam Classification of Academic E-mails: A Machine Learning Approach

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Abstract In the academic environment, players have overstretched University faculty with less available time. The task of reading and deleting electronic mail (e-mail) spam tends to consume or steal the little available time they have at their disposal. Due to the spam issue, automated processes or methods for separating spam from valid emails are becoming important. Due to the unstructured nature of the material, additional features, and a vast number of documents, the process of automatically classifying spam email presents significant difficulties. Increasing usage of the e-mail spam directly affects the performance of these spam classifications with regards to the quality and speed based on the challenges stated above. Most of the recent algorithms consider only relevant features or characteristics for the classification of the e-mails as spam or legitimate. The main objective of this work was to use a machine-learning algorithm to detect and categorize e-mail messages of university faculty into spam and non-spam with the identification of the most occurring attributes that are contained in the messages. These attributes helped in the generation of a classification model based on the Random Forest algorithm. Exploratory analysis of the academic e-mails revealed that the most occurring attributes that are easily associated with spam messages included "your", "open access" and "remove". Five hundred decision trees were generated in the Random Forest Model, which had an excellent classification accuracy of 0.942 (94.2%). The performance of the model was compared with similar models based on the random forest algorithm. The comparative analysis revealed that classification accuracy differs depending on the type of e-mails used.

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1   Introduction

The world today is virtually linked up together which is usually referred to as a
"global village". This is made possible with the use of the internet. Information
sharing has become very easy and convenient with the use of the internet. Electronic
mail is one of the most used applications on the internet. In businesses, education
and even within relations which includes friends and family ties, etc. the impact of
the internet is felt in all these areas [1].

The problem of spam is a very challenging issue faced by businesses, organizations
and other e-mail users [2]. The negative impact of this problem is seen across many
activities that require the use of e-mail for the sending and receiving of messages [2].
The damage or problem that is associated with the use of the e-mail application as
a result of spam messages includes; the waste of time of the user, loss of important
messages, crimes, overloading of communication and the irritation and the discontent
of the user [3]. The user who usually relies on the e-mail will have quite a number
of e-mails to look at. With the increasing number of important e-mails, the user also
ends up reading a higher number of spam e-mails as well. The user straight away
is irritated with the amount of time and energy he will spend in deleting the spam
messages. He or she may end up deleting even important messages.

Spam messages tend to overload the communication network creating traffics
which introduces an extra cost to the user or the provider. Mail service providers
in their measures to avert some of these problems will have to hire a specialist to
maintain their system who will have to be paid huge sums of money which is also
an additional cost to these Service Providers. An example of the criminal activities
that are associated with the spam mail is the sending of malicious programs that steal
valuable information from the user by the infected links the user receives [4].

Tools and measures available for organizations to consider in the effort to curb
e-mail spam messages in their respective workplaces are to ensure that, the users
are trained and educated intermittently in the use of the e-mails and the operation of
spammers and also leveraging on anti-spam services, corporate e-mail system, e-mail
filtering gateways, which will provide an efficient and effective means to handle spam
message for organizations [5]. The popularity of e-mail can be attributed to the fact
that it is extremely cheaper and easier to send and also very fast in terms of exchanging
messages between friends, relations, organizations and governance. In the absence
of having in place a system or methods to remove spam messages, spammers will
flood network systems, decrease employee efficiency, steal bandwidth, and still be
there tomorrow to adopt different strategy to cause numerous problems for internet
users [5]. Users of the internet begin to have confidence when they are able to identify
spam and remove it, makes them regain accurate communications.

According to [6], e-mail application usage is anticipated to rise to about 4.2 billion and over by the end of 2022. The e-mail application has become a key component in the daily living of every individual in the world today. Increment in the usage of the e-mail goes with some challenges. E-mail spam is the biggest challenge or problem in the use of the e-mail. In spite of the technological advancement, there has been a far-reaching spread of spam e-mails across the internet and it continuous to create challenges.

Different means have been devised for the spread of e-mail spam and network security [7]. An E-mail spam, which is also referred to as junk mail, is usually unsolicited marketing messages sent through e-mails. Greater percentage of e-mail has been shown by statistics to be spam and cause internet users about $355 Million per day [8]. Inexpensive pharmaceutical drugs, weight loss programs, online degrees, job opportunities and online gambling are the main objectives for using the spam e-mails.

Spammers collect e-mail addresses from chartrooms, websites, customer lists and news groups. These collected e-mails are then sold to other spammers who use them to send or distribute their own spam message for their personal gain. Some other ways by which spammers collect e-mail addresses is by the use of "spambot" which is a crawler that crawls on the internet to collect e-mail address [9]. Internet Protocol (IP) addresses are sometimes used to generate the list of the e-mail addresses used by the spammers by a technique called the "Snowshoe" [10].

The e-mail spam normally possesses some obvious characteristics that one can identify but because of the waste of time and the frustration that arise when one is looking for a legitimate mail makes it prudent for this type of e-mail to be automatically identified and removed. Some of these characteristics are; the mail is not addressed to a specific recipient, improper sender's address, the greeting or salutation of the spam mail is usually in a generic form such as "Hello", the subject of the e-mail is awkward and does not carry any meaningful information. In some cases, the domain reference is forwarded to another domain. Another common characteristic is bad grammar and lack of telephone numbers as part of the signature [11].

Machine learning techniques are among the branches of artificial intelligence that make computer or machines capable of learning just as the way humans learn. Machine learning has seen tremendous advancement as part of the Artificial Intelligence (AI) field. Machines are made capable to exhibit the intelligence as shown by humans, performing equally or even better than humans in some domains [12]. The machine learning techniques ensure the intelligence of machines by training of the machines from a set of data and based on this experience the machines develop and builds intelligence [12]. The machine learning technique can be categorized or put into three groups; Supervised, unsupervised and hybrid [12]. The Supervised learning or learning with guide, function by finding some hidden pattern or information from the dataset provided, which it uses as inference in predicting incidence with the same characteristics. Sometimes the Supervised learning tries to identify the anomalies in the given dataset. The Unsupervised learning on the other hand, only uses the input data with no labels, thus no target data points. Clustering of the data points are based on how similar the data points are. The Hybrid techniques combine

the strength of both Supervised and Unsupervised machine learning, making it more efficient than the individual machine learning technique [13].

It is a fundamental issue to create and take measures to deal with spamming. Without a doubt, perhaps the best measure toward this path is spam filtering. Spam filtering fundamentally incorporates two significant methodologies: Knowledge Engineering (KE) and Machine Learning (ML) [14]. Spam filtering procedures dependent on KE utilizes a lot of predefined and client characterized rules. These rules are executed to distinguish the essential qualities of the e-mail message. In any case, it has been seen that KE based spam filtering suffers from poor generalization [14].

Through the use of a training dataset—a collection of emails—ML techniques create a classifier. Studies have demonstrated that ML-based spam filters outperform KE spam filters in terms of generalization [14]. Significant research has been conducted in the fields of spam classification and email categorization for many years, and the Naive Bayes classifier and Support Vector Machines are two of the most often used techniques (SVMs) [15].

The use of the Random Forest (RF) algorithm to help detect and categorize e-mails in academia as spam and non-spam e-mails to alleviate frustrations and other problems faced by academics in the usage of the e-mail application is the objective of this work.

2   Materials and Methods

Data used for the development and implementation of the RF based classifier was obtained from a random sample of lecturers of the University of Energy and Natural Resource (UENR). It comprised 1813 academic e-mails of which 808 were spam and 1005 were not spam.

The generation of the classifiers for the academic e-mails was first preceded by the pre-processing of the dataset. The data pre-processing basically involves (1) tokenization, which is about splitting of sentences in the entire e-mails into individual words, (2) removal of stop words such as 'for', 'is', 'if', etc. and (3) stemming, which is the process of reducing a word and its variations into one word [16]. The data pre-processing was immediately followed by feature extraction, which is the identification and selection of the most important words which can be used to train the classifier.

The outliers for each attribute were indentified, removed and replaced. The outliers were replaced by the mean value of the column or attribute. The partitioning of the dataset for classification was done in the ratio 80:20, which means that 80% of the data were used for training the classifier while 20% of the data were used for testing the performance of the classifier.

The RF classifier was generated based on the votes cast of the individual trees in the forest at a given input. RF usually depends on two major techniques known as bagging and boosting. A method for minimizing the variance of an estimated

Table 1 Algorithm of the random forest [17]

1. For b = 1 to B:
(a) Draw a bootstrap sample Z^* of size N from the training data
(b) Grow a random-forest tree T_b to the bootstrapped data, by recursively repeating the following steps for each terminal node of the tree, until the minimum node size n_{min} is reached
i. Select m variables at random from the p variable
ii. Pick the best variable/split-point among the m
iii. Split the node into two daughter nodes
2. Output the ensemble of tree $\{T_b\}_1^B$
To make prediction at a new point x:
Regression: $\widehat{f}_{rf}^B(x) = \frac{1}{B}\sum_{b=1}^B T_b(x)$.
Classification: Let $\widehat{C}_b(x)$ be the class prediction of the bth random-forest tree
Then $\widehat{C}_{rf}(x) = majorityvote\{\widehat{C}_b(x)\}_1^B$

prediction function is bagging or bootstrap aggregation. The committee technique of boosting was previously presented, but unlike bagging, the committee of weak learner's changes over time and the members give a weighted vote. Although Boosting looks to outperform bagging on the majority of situations, bagging is still seen to do well with trees.

RF is both used for classification and regression. In classification, every tree cast a vote to determine the class. Regression is obtained when using the RF by averaging the various predictions of each tree in the forest. One crucial aspect of RF is its Out-of-Bag (OOB) estimates or samples, which provide a way to assess the accuracy of predictions made by random forests, boosted decision trees, and other machine learning models that make use of bootstrap aggregation. Using just the trees that did not include xi in their bootstrap sample, OOB provides the mean prediction error on each training sample xi.

After the optimal number of trees, M is obtained. A set of data point is selected to generate the trees which are needed to build the RF. The number of trees will be less or equal to the optimal number of trees needed. The Tree or the decision tree is built based on the splitting of the data point with respect to the attributes being considered in this spam detection (Table 1).

3　Results and Discussion

Fifty-eight features were selected and used in the training of the RF classifier for the classification of academic e-mails. As a preliminary step of the analysis, correlations were computed to measure the strength of the relationship between each feature and the outcome variable ('status'). The blue colour in the correlation diagrams (Figs. 1

and 2) indicate positive relationships while the red colour indicate negative relationships. Deeper colours represent stronger relationships while lighter colours represent weaker relationships. The first ten (10) features as shown in Fig. 1, did not show strong correlations with the outcome variable except the features "word_freq_order", "word_freq_remove" and "word_freq_our".

The correlations shown in Fig. 2 indicate all eleven features correlated weakly with the outcome variable. However, stronger relationships were observed among some of

Fig. 1 Feature attributes correlations for the first ten features
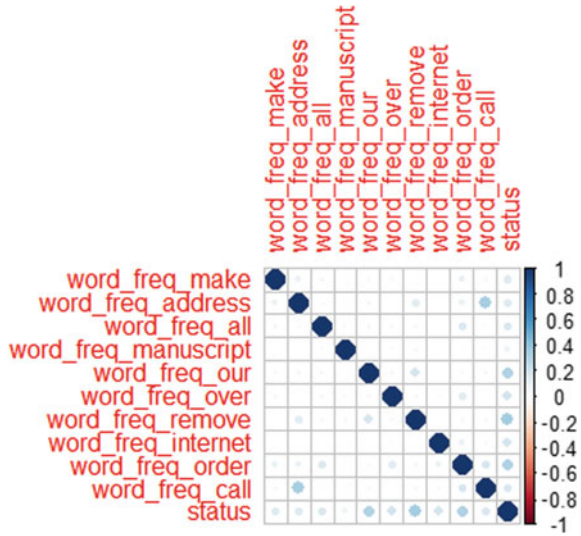
Fig. 2 Feature attributes correlations for the second eleven features
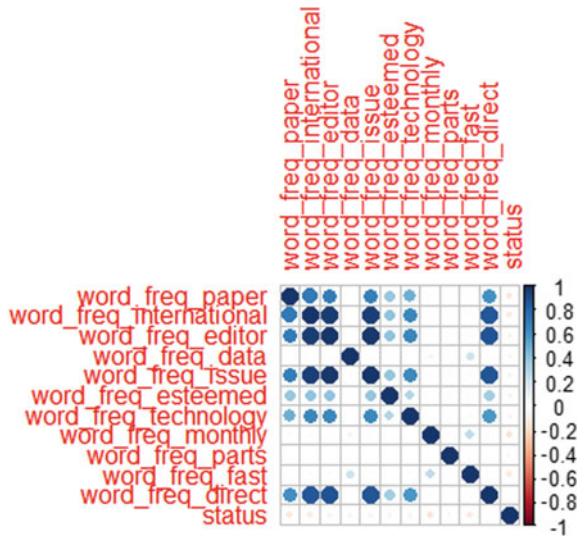
the features. For instance, very strong positive correlations were observed between the features, "word_freq_editor", "word_freq_issue", and "word_freq_international".

The importance of each of the extracted features in classifying academic e-mails as spam or not spam based on the RF classifier is presented in Fig. 3. The plot provides a list of the top 30 most important features in academic e-mail spam classification in descending order by a mean decrease in Gini. The top features such as the "capital_run_length_average", "capital_run_length_longest", "capital_run_length_total", "word_frequency_remove" and "word_frequency_free" contribute more in classifying academic e-mails as spam or not spam.

The performance of the RF classifier on the training dataset is presented in Table 2. Out of a total 792 e-mails that are not spam, 766 were correctly classified as not spam while 26 were wrongly classified as spam. Also, out of a total of 659 spam emails, 603 were correctly classified as spam while 56 were misclassified as not spam. This gives an overall within sample accuracy of about 94.3%.

Table 3 shows the performance of the generated RF classifier on the testing data which gave an accuracy of 0.942, classifying 21 e-mails wrongly out of a total of 362. This gives an indication that the generated RF classifier is quite good.
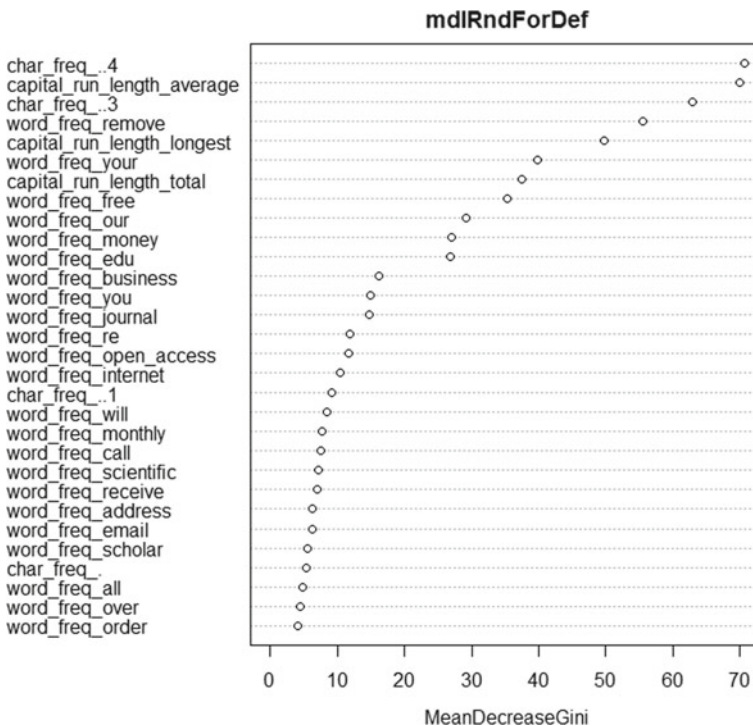
Fig. 3 Variable importance plot

Table 2 Confusion matrix of the generated random forest model based on the training data

	Not spam	Spam	Class error
Not spam	766	26	0.03282828
Spam	56	603	0.08497724

Number of trees: 500

Number of variables tried at each split: 8

OOB estimate of error rate: 5.65%

Table 3 Confusion matrix of the generated random forest model based on the testing data

	Not spam	Spam
Not spam	200	13
Spam	8	141

Accuracy: 0.942

95% CI: (0.9127,0.9637)

No information rate: 0.5746

P-value [Acc > NIR]: < 2e−016

Kappa: 0.8808

Table 4 Accuracy statistics for the fitted random forest model

Accuracy measure	Value
Mcnemar's test P-value	0.3827
Sensitivity	0.9615
Specificity	0.9156
Pos pred value	0.9390
Neg pred value	0.9463
Prevalence	0.5746
Detection rate	0.5525
Detection prevalence	0.5884
Balanced accuracy	0.9386
'Positive' class	Not spam

Further accuracy measures for the generated RF classifier are presented in Table 4. Among others, the sensitivity and specificity of the generated RF classifier are 96.15% and 91.56% respectively. This means that the RF classifier will classify 96.15% of academic e-mails that are not spam correctly, but it will also fail to classify 3.85% of such e-mails correctly. Also, the RF classifier will correctly classify 91.56% of academic e-mails that are spam, but it will also misclassify about 8.44% of such e-mails.

4 Conclusions

The increasing trend of e-mail spam in the academia requires that more algorithms or detection techniques are needed to help filter academic e-mail spam efficiently. In this study, a Random Forest classifier to help in the detection and classification of e-mails in academia as spam and non-spam, to alleviate frustrations and other problems faced by academics in the usage of the e-mail application has been developed. The random forest model created, had within it 500 decision trees, which yielded an out-of-sample classification accuracy of 94.2%. The classification error based on the confusion matrix was 0.033 for ham e-mails that were wrongly classified as spam, and 0.085 for spam e-mails that were wrongly classified as ham. The prediction error based on the Out-of-Bag (OOB) estimate of the error rate was 5.65% which confirms the fact that, the RF classifier generated in this study is quite good.

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Crime Analysis and Prediction in 7 States of India Using Statistical Software RStudio

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Abstract Crime analysis is a function of law enforcement. It comprises systematized analysis for understanding the movement of crime patterns. Crime is an increasing factor all over the world and the condition in India is the same. Common people feel insecure as they feel there is no safe place left in this world. It is also well known that crime increases with population and by looking at any year's population count of India it can be said how crime rate goes a step forward from the previous year. In this paper, data for the top 3 crimes in India namely Rape, Dowry death and Domestic violence is collected and pattern is analyzed using Holt's Linear Trend method (aka Double Exponential Smoothing). Through this paper, the respective crime patterns and future values are forecasted. The statistical computations and graphical presentation have been done with the help of the statistical software RStudio.

Keywords Crime analysis · Holt's linear trend method (aka double exponential smoothing) · RStudio

1   Introduction

Crime analysis can occur at various levels, including tactical, operational, and strategic. Crime reports as well as arrests reports and police calls are studied by

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crime analysts to identify developing patterns and trends as quickly as possible. The concept of crime has been defined from the social and legal stand point. According to Morwer, crimes are defined to be an anti social act while Thorstein Sellin says crime is nothing but violation of conduct norms of the normative group. Socio economic changes have been witnessed by India since independence. With increase in development and urbanization of big cities and towns there is also an increase in the rate of crimes. People feel very insecure in the presence of evil element in the society. According to Google, the major crimes of India are Rape, Dowry death, Domestic violence, Illegal drug trade, Arms trafficking etc. According to Crime Bureau of India, the cases of rape molestation and sexual assaults increased to about 44, and 60% of them being girls under 18 years of age. This paper is limited to the study for the top 3 crimes in India namely Rape, Dowry death and Domestic violence due to lack of sufficient data for the rest of the crimes.

The National Crime Records Bureau states that in every twenty minutes one woman gets to be the victim of rape in India. A 23y/o rape victim was set on fire while she was on her way to the court for a hearing. And while there is an ongoing crisis due to the Covid 19 pandemic there is an exponential increase in marital rape, domestic violence, dowry death and sexual assault on both upper and lower class women. In India the concept of violence against women is very common. Women have to face violence not only from husbands but also from members of both the natal and the marital home. Girls and women in India do not usually get much privilege like the boys in terms of their position not only society but also in their families as well. The very idea of dowry is a important part in the domestic violence category.

Government of India sanctioned various laws such as Section 376A, Section 376B, Section 376C, Section 376D, Section 304B, Section 113B, Dowry Prohibition Act, 1961, The Protection of Women from Domestic Violence Act, 2005 and Section 498A against the illustrated crimes.

Time series analysis is not a new phenomenon. It can be used in a multitude of business applications for forecasting a quantity into the future and explaining its historical patterns. Holt's Linear Trend Model is a time series forecasting procedure which is also known as Double Exponential Smoothing. It is a popular smoothing model for forecasting data with trend.

2   Literature Review

The tremendous rise in the information and communications technology has not only changed many of our beliefs, habits and traditions, but also has introduced a new wave of young billionaires. Holt's Linear Trend Method has been used to forecast stock market predictions [1], used for determining the major ambient air pollutants [2, 3]. Michel and Makowski have compared statistical models for analyzing wheat yield time series using this process [4]. After using eight different forecasting models, their findings concluded that Holt's Linear Trend model shows better performance than others. CSRTI (Mysore) Scientists have used this method for time series forecasting

(a) Data for number of rapes committed

Year	Rajasthan	UP	MP	Maharashtra	Kerala	Assam	Haryana
2001	1049	1958	2851	1302	562	817	398
2002	1051	1415	2891	1352	499	970	361
2003	1050	911	2738	1268	394	1095	353
2004	1038	1397	2875	1388	480	1171	386
2005	993	1217	2921	1545	478	1238	461
2006	1085	1314	2900	1500	601	1244	608
2007	1238	1648	3010	1451	512	1437	488
2008	1355	1871	2937	1558	568	1438	631
2009	1519	1759	2998	1483	568	1631	603
2010	1571	1563	3135	1599	634	1721	720
2011	1800	2042	3406	1701	1132	1700	733
2012	2049	1963	3425	1839	1019	1716	668
2013	3285	3050	4335	3063	1221	1937	971
2014	3759	3467	5076	3438	1347	1980	1174
2015	3644	3025	4391	4144	1256	1733	1070
2016	3656	4816	4882	4189	1661	1779	1189
2017	3305	4246	5562	1933	2035	2048	1104
2018	4335	3946	5433	2142	1972	1767	1296
2019	5997	3065	2485	2299	2044	1791	1480

(b) Data of dowry death

Year	Rajasthan	UP	MP	Maharashtra	Kerala	Assam	Haryana
2001	376	2211	609	308	27	59	285
2002	399	1893	674	303	17	70	256
2003	589	1322	648	368	33	60	222
2004	379	1708	751	314	31	74	251
2005	361	1564	739	341	21	99	212
2006	394	1798	764	387	25	105	255
2007	439	2076	742	436	27	100	269
2008	439	2237	805	390	31	103	302
2009	436	2232	858	341	20	170	281
2010	462	2217	892	393	22	175	284
2011	514	2322	811	339	15	121	255
2012	478	2244	743	329	32	140	258
2013	453	2335	776	320	21	170	263
2014	405	2469	733	279	28	188	293
2015	463	2335	664	268	8	216	243
2016	462	2473	629	248	25	157	260
2017	458	2711	635	239	12	193	254
2018	405	2521	547	200	17	176	216
2019	453	2424	550	196	8	164	248

(c) Data of domestic violence

Year	Rajasthan	UP	MP	Maharashtra	Kerala	Assam	Haryana
2001	5532	7365	2562	6090	2561	1248	1513
2002	5691	5679	3117	5353	2836	1694	1565
2003	5733	2626	2958	5452	2930	1808	1618
2004	6781	4950	3436	5646	3222	1945	2026
2005	4505	5997	2989	6233	3283	2206	2075
2006	7038	5204	2989	6738	3708	2548	2254
2007	7650	8170	3294	7356	3999	3000	2412
2008	8113	8312	3185	7829	4138	3478	2435
2009	10371	8566	3983	7681	4007	4398	2617
2010	11145	7978	3756	7434	4797	5410	2720
2011	12218	7121	3732	7136	5377	5246	2740
2012	13312	7661	3988	7415	5216	6407	3137
2013	15094	8781	4998	8542	4820	8636	3617
2014	15905	10471	6451	7696	4919	9626	3478
2015	14383	8660	5281	7640	3668	11225	3525
2016	13814	11166	6264	7215	3462	9321	3314
2017	11508	12895	6144	6711	3021	10598	3389
2018	12363	14361	4160	6882	2070	11261	4195
2019	18453	18617	5487	8561	3039	11943	4875

Fig. 1 **a** Data for number of rapes committed. **b** Data of dowry death. **c** Data of domestic violence

in agricultural research and to forecast the export of tea from India up to the year 2020 [5, 6]. According to a study conducted by Oni and Akanle [7] this method was proven to be the best one to describe the data having the lowest error in their study of comparing exponential smoothing models for forecasting Cassava production.

3 Methodology

The methodology uses Holt's Linear Trend method (known as Double Exponential Smoothing) on data-sets obtained from National Crime Records Bureau. This method consists of three steps mainly: (1) Data Exploration, (2) Method Applied, (3) Analysis. These steps are discussed in further subsections.

3.1 Data Exploration

This analysis involves the yearly data for no. of Rapes committed, Dowry death and domestic violence from the year 2001–2019. The data has been collected for 7 states of India—Rajasthan, Uttar Pradesh, Madhya Pradesh, Maharashtra, Kerala, Assam and Haryana. The data has been collected from NCRB.gov.in (Fig. 1).

3.2 Method Applied

The method used here is Holt's Linear Trend method which is also known as Double Exponential Smoothing. It is a popular data-driven method for forecasting series with a trend but no seasonality. The main idea in this method is to take the simple exponential smoothing set up but to add a trend component.

This method involves 3 equations:

i.   ŷt + k = at + kct: forecast equation
ii.   at = γyt + (1 − γ)(at − 1 + ct − 1): level equation
iii. ct = δ(at – at − 1) + (1 – δ)ct − 1: trend equation

Here,

smoothing constant for level. $0 < \gamma < 1$, δ: smoothing constant for trend. $0 < \delta < 1$,

*a*t: estimate of the level. ct: estimate of the trend., *y*t: observation at time t.

3.3 Analytical Study of Crimes in Main 7 States of India

RStudio is used for analyzing datasets. RStudio is recommended professional data science solution IDE. It comprises of a set of integrated tools designed to be more productive with R and Python. It includes a console, syntax-highlighting editor that supports direct code execution, and a variety of robust tools for plotting, viewing history, debugging and managing workspace. The states are analyzed for three different crimes one by one. The descriptive analysis is mentioned below:

3.3.1   Crime Analysis in Rajasthan

The number of rape cases in Rajasthan were more or less the same from 2001 to 2012 and after that a slight increasing trend is observed. From the graphical plot, the no. of rapes committed between 2020 and 2029, will increase upto 11,649 by the end of 2029 from 5997 by the end of 2019. According to the 95% confidence interval there can be a hike of about 18,479 in rape cases by 2024 or there can be a huge decline in the crime of about 4819.

In case of domestic violence an upward trend can be observed from the year 2005–2015 and after that a slight decline is observed till the year 2018. From the plot, the domestic violence numbers between 2020 and 2029, will increase upto 22,892 by the end of 2029 from 18,453 by the end of 2019. According to the 95% confidence interval there can be a hike of about 26,783 in domestic violence by 2024 or there can be a decline in the crime of about 19,000.

Now dowry death is a category that falls under domestic violence. It means that at the end of 2019 about 2% of domestic violence ended in the death of woman. Here the 95% ci is 339 and 618 i.e. by the end of 2029 the number of death due to dowry can increase upto 618 or can decline up to 339. Table 1 analyses the next 10 years forecast (approx. values) for crimes in Rajasthan (Fig. 2).

Table 1 Rajasthan 10 years crime forecast

Year	RAPE	Domestic violence	Dowry death
2020	6562	17,018	448
2021	7127	17,670	451
2022	7693	18,323	455
2023	8259	18,976	458
2024	8823	19,629	461
2025	9388	20,281	465
2026	9954	20,934	469
2027	10,519	21,587	472
2028	11,084	22,239	476
2029	11,649	22,892	479
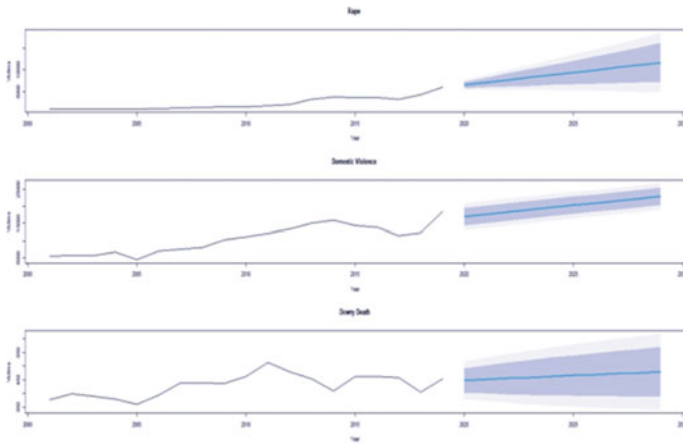
Fig. 2 Rajasthan crime analysis

3.3.2 Crime Analysis in Uttar Pradesh

In case of Uttar Pradesh after a sudden drop in rape cases in the year 2003 the number of the crime has been more or less the same from 2004 to 2012. After that an increase in rape cases is observed till the year 2016 (Fig. 3).

Again there is a drop in cases from 2016 to 2019. From the forecasted region an increasing trend is observed. The number of rapes committed will reach 4525 by the year 2029 from 3065 which was observed at the end of the year 2019. Here the 95% confidence interval is (1577, 7472) which means by 2029 the number of rape cases may be as high as 7472 or as low as 1577.

The number of domestic violence victims are more or less the same in case of Uttar Pradesh till the year 2015 and after that a slight increase is observed. The domestic violence numbers will increase upto 26,458 by the end of 2029 from 18,617 by the
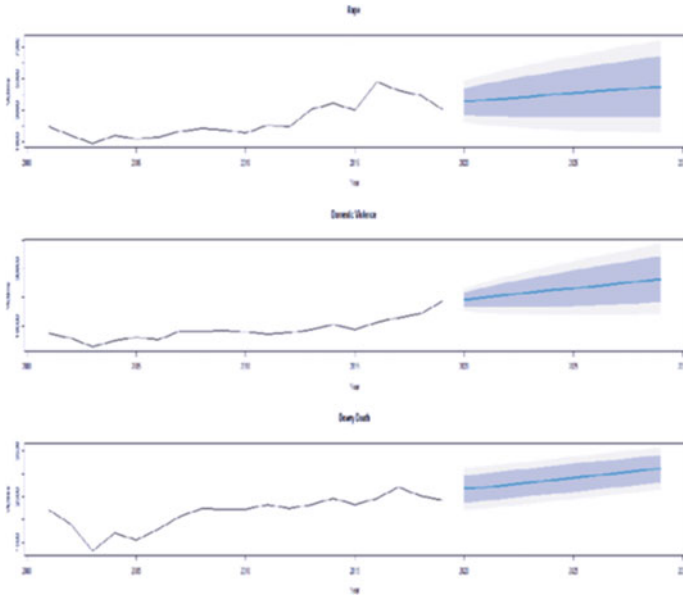
Fig. 3 Uttar Pradesh crime analysis

end of 2019. Here the confidence interval is (14,081, 38,835) which means the crime numbers can reach up to 38,835 by the year 2029 or may fall up to 14,081.

The plot shows a significant drop in cases in the year 2003 but since then an increasing trend is observed. At the end of 2019 about 13.02% domestic violence cases ended in dowry death. This percentage will decrease to 11.75% by the end of the year 2029. The 95% confidence interval says that the number of cases may be as high as 3574 or as low as 2647 by the year 2029. Table 2 illustrates the next 10 years forecast (approx. values) in Uttar Pradesh.

Table 2 Uttar Pradesh 10 years crime forecast

Year	RAPE	Domestic violence	Dowry death
2020	3559	19,248	2662
2021	3667	20,049	2712
2022	3774	20,850	2762
2023	3881	21,651	2812
2024	3988	22,453	2861
2025	4096	23,254	2911
2026	4203	24,055	2961
2027	4310	24,856	3011
2028	4417	25,657	3061
2029	4525	26,458	3110

3.3.3 Crime Analysis in Madhya Pradesh

A significant drop in number of cases is observed in the year 2018 in rape cases in Madhya Pradesh. The number of cases are almost same over the years from 2001 to 2012 and after that the case numbers are seen to be getting high. According to the forecasted region there is a rise of 45.35% in the cases from the year 2019–2029. Here the 95% confidence interval is (6267, 7111) (Fig. 4).

After being more or less the same in number of domestic violence cases from the years 2001–2011 a significant increase is seen. The number of cases drop at the year 2018. According to the forecast by the year 2029 the number of cases will increase upto 7243 from 5487 in the year 2019. The 95% confidence interval indicates that there may be a rise in cases of 8743 or a drop in cases by 5744 by the end of 2029.

The number of death due to dowry is more or less high in case of Madhya Pradesh. But from the year 2010 a decreasing trend is observed. At the end of 2019 about 10.02% domestic violence cases ended in dowry death. This rate will decrease a significant amount—2.65% by the end of the year 2029. From the 95% confidence interval the number of cases can be as high as 881 or there may be no cases at all. Table 3 illustrates the next 10 years forecast (approx. values) for crimes in Madhya Pradesh.
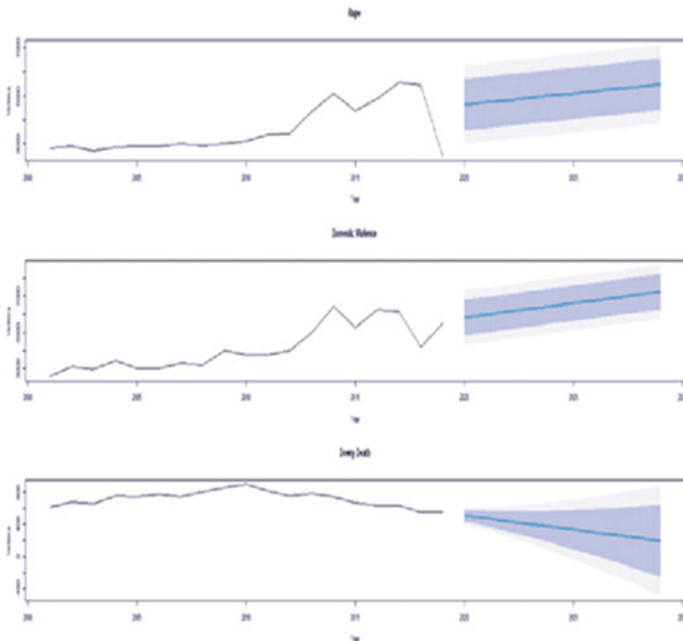

Fig. 4 Madhya Pradesh crime analysis

Table 3 Madhya Pradesh 10 years crime forecast

Year	RAPE	Domestic violence	Dowry death
2020	4636	5819	503
2021	4730	5978	468
2022	4823	6136	434
2023	4917	6294	399
2024	5011	6452	365
2025	5105	6610	330
2026	5198	6769	296
2027	5292	6927	262
2028	5386	7085	227
2029	5480	7243	192

3.3.4 Crime Analysis in Maharashtra

In case of Maharashtra the number of rape cases are at a constant level from 2001 to 2012 after which there is a little increase from the year 2012–2016. According to the forecasted region the number in cases goes to 3064 in the year 2029 from 2299 in the year 2019. The 95% confidence interval is $(-1279, 7408)$.

In Maharashtra the numbers are more or less the same in domestic violence cases. According to the forecast by the year 2029 the number of cases will increase upto 9883 from 8651 in the year 2019. The 95% confidence interval indicates that there may be a rise in cases of 14,128 or a drop in cases by 5693 by the end of 2029 (Fig. 5).

The number of death due to dowry is more or less high in case of Maharashtra. But from the year 2010 a decreasing trend is observed. At the end of 2019 about 2.3% domestic violence cases ended in dowry death. This rate will decrease a significant amount—0.42% by the end of the year 2029. From the 95% confidence interval the number of cases can be 459 or there may be no cases at all. Table 4 represents the next 10 years forecast (approx. values) for crimes in Maharashtra.

3.3.5 Crime Analysis in Kerala

From the plot it can be seen that the number of rape case is increasing in the upcoming 10 years. We see that, by the end of 2019, the crime number is 2044 which will be increasing by the end of 2029 and becomes around 3710. The 95% C.I. is (38.55, 7455.80). Hence, we can say that, by 2024, the crime number can go up as high as approximately 7446 or as low as 39 (approx.). So, looking at the fluctuations, it can be lesser than the crime rate observed by the end of 2019. But in general, the forecasts show a more or less increasing rate over the time period.

In Kerala the numbers are more or less the same in domestic violence cases, with a decrease from the year 2014 to the year 2018. According to the forecast by the year 2029 the number of cases will increase upto 3747 from 3039 in the year 2019. The
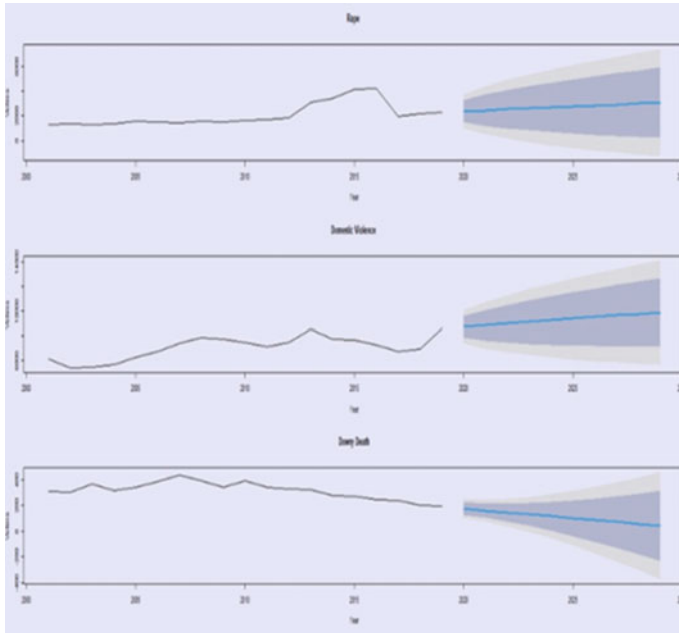
Fig. 5 Maharashtra crime analysis

Table 4 Maharashtra 10 years crime forecast

Year	RAPE	Domestic violence	Dowry death
2020	2375	8693	174
2021	2452	8825	160
2022	2529	8958	145
2023	2605	9090	130
2024	2682	9222	116
2025	2758	9354	101
2026	2835	9487	86
2027	2911	9619	72
2028	2988	9751	57
2029	3064	9884	42

95% confidence interval indicates that there may be a rise in cases of 7456 (approx.) or a significant drop in cases by 39 (approx.) by the end of 2029 (Fig. 6).

An unusual trend is observed throughout the years in case of dowry death in Kerala. At the end of 2019 about 0.26% domestic violence cases ended in dowry death. By the end of 2029 the number of dowry death cases will be 8 (approx.) which is same at the year 2019. From the 95% confidence interval the number of cases can
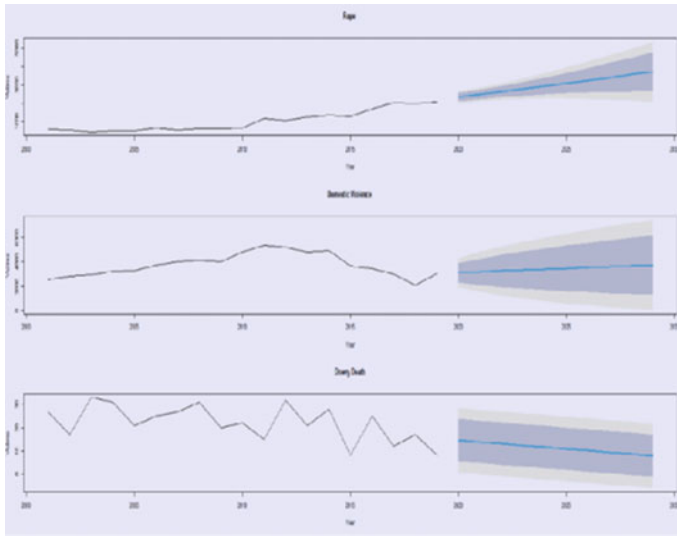
Fig. 6 Kerala crime analysis

Table 5 Kerala 10 years crime forecast

Year	RAPE	Domestic violence	Dowry death
2020	2323	3110	15
2021	2477	3181	14
2022	2631	3251	13
2023	2785	3322	12
2024	2939	3393	12
2025	3094	3464	11
2026	3248	3535	10
2027	3402	3605	9
2028	3556	3676	9
2029	3710	3747	8

be 22 (approx.) or there may be no cases at all. Table 5 represents the next 10 years forecast (approx. values) for crimes in Kerala.

3.3.6   Crime Analysis in Assam

In Assam, the number of rape committed shows a decreasing nature in the next 10 years. In the beginning of 2001, the crime number was as high as 1473 which decreased by the end of 2029–1315 (approx.). The 95% confidence interval is (67.49, 2561.85). This means that the number of the crime is as low as 67 (approx.) to as

Table 6 Assam 10 years crime forecast

Year	RAPE	Domestic violence	Dowry death
2020	1776	12,522	200
2021	1725	13,123	199
2022	1674	13,723	198
2023	1622	14,324	197
2024	1571	14,924	196
2025	1520	15,525	195
2026	1469	16,125	193
2027	1417	16,726	192
2028	1366	17,327	191
2029	1315	17,927	190

high as 2562 (approx.). In Assam the numbers are more or less the same in domestic violence cases till 2010, after which an increasing trend is observed.

According to the forecast by the year 2029 the number of cases will increase upto 17,927 from 11,943 in the year 2019. The 95% confidence interval indicates that there may be a rise in cases of 22,465 (approx.) or a significant drop in cases by 13,389 (approx.) by the end of 2029.

Again, in case of Assam an unusual trend is observed throughout the years. At the end of 2019 about 1.37% domestic violence cases ended in dowry death. By the end of 2029 the number of dowry death cases will be 190 (approx.). From the 95% confidence interval the number of cases can be as high as 303 (approx.) or as low as 77 (approx.). Table 6 illustrates the next 10 years forecast (approx. values) for crimes in Assam (Fig. 7).

3.3.7 Crime Analysis in Haryana

After being more or less the same from 2001 to 2011 the number of rape case show an increasing trend in Haryana. From the forecasted region also, an increasing trend is observed. The number of rapes committed will reach 1969 by the year 2029 from 1480 which was observed at the end of the year 2019. Here the 95% confidence interval is (1608.66, 2329.88) which means by 2029 the number of rape cases may be as high as 2330 (approx.) or as low as 1609 (approx.) (Fig. 8).

In case of domestic violence an increasing trend is observed in Haryana. The number this crime committed is also increasing in the upcoming 10 years. According to the forecast by the year 2029 the number of cases will increase upto 5680 from 4875 in the year 2019. The 95% confidence interval indicates that there may be a rise in cases of 6227 (approx.) or a drop in cases by 5113 (approx.) by the end of 2029.

An unusual trend is observed throughout the years in case of dowry death in Haryana. At the end of 2019 about 5.08% domestic violence cases ended in dowry death. By the end of 2029 the number of dowry death cases will be 259 (approx.).
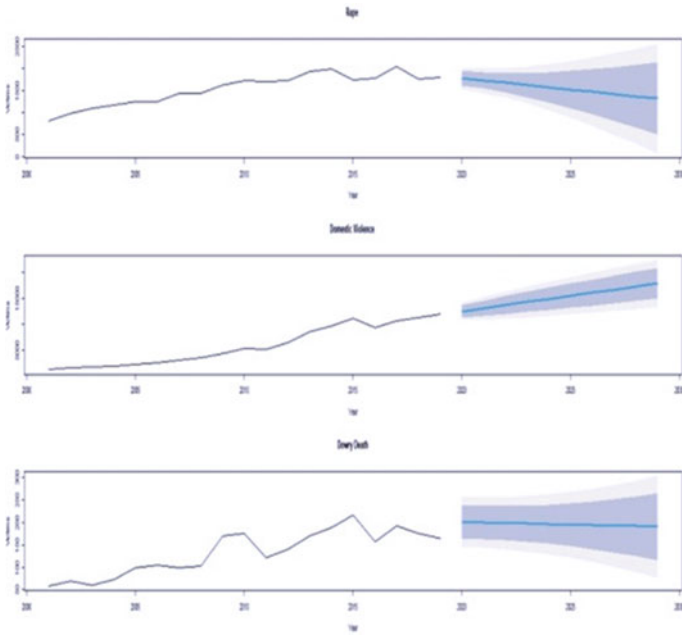
Fig. 7 Assam crime analysis
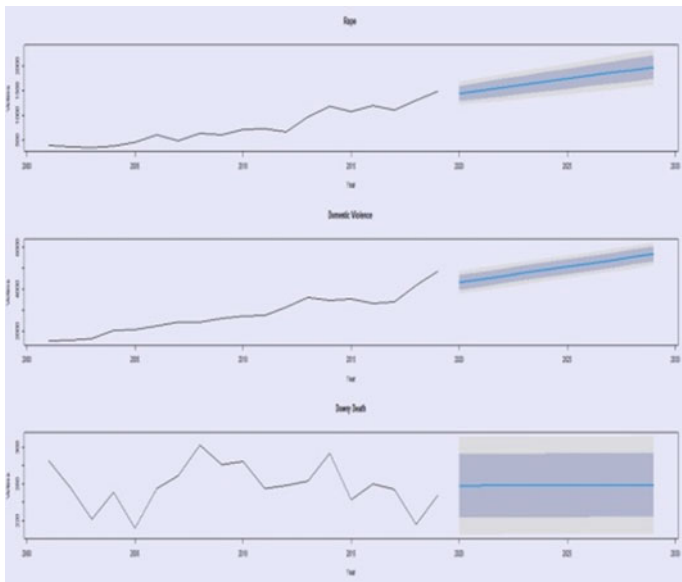
Fig. 8 Haryana crime analysis

Table 7 Haryana 10 years crime forecast

Year	RAPE	Domestic violence	Dowry death
2020	1776	12,522	200
2021	1725	13,123	199
2022	1674	13,723	198
2023	1622	14,324	197
2024	1571	14,924	196
2025	1520	15,525	195
2026	1469	16,125	193
2027	1417	16,726	192
2028	1366	17,327	191
2029	1315	17,927	190

Here the 95% confidence interval is (205.74, 311.5). Table 7 represents the next 10 years forecast (approx. values) for crimes in Haryana.

4 Conclusion and Future Scope

The number of crimes reported is observed to be increasing over the years. Rape cases and Domestic Violence is increasing in 6 states namely Rajasthan, Madhya Pradesh, Uttar Pradesh, Maharashtra, Kerala and Haryana and decreasing in 1 state i.e. Assam. However, Dowry death is decreasing in 3 states including Madhya Pradesh, Maharashtra, Kerala and increasing in 4 states. UP would be the most unsafe place in the upcoming years. Due to COVID-19, year 2020 datasets are not explored. The crimes in consideration are gender biased. However Men also experience some sort of torture or violence at the hands of their wives or their intimate partners in their lifetime. Crimes likes these generally do not get reported and are not included in survey.

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The Benefits and Challenges of Social Media in Higher Education

Alhassan Fatawu, Mohammed Abdul-Basit Fuseinii, and Abdul-Mumin Khalid

Abstract The purpose of this chapter is to identify key benefits and challenges of social media usage by higher education sector. It has been found that the use of online social networks can have a positive impact on students' education. Students have a lot to gain from using social media, from building business networks to finding work to becoming a source of income. It teaches students to see the world from a broader perspective and to consider issues from a broader perspective. Learning has become more enjoyable thanks to social media. It has elevated classroom instruction above the level of textbooks and lecture halls by promoting dialogue and the exchange of ideas. The challenges found were cyber-bulling, waste of time, mind diversion amongst others. It was concluded that social media is a wonderful online resource for students to use to further their education. The evaluation of social media is causing everyone's lives to become significantly different. The government must make sure that the digital hazards authority examines how sites promote content in order to safeguard susceptible people in the end and foster public trust.

Keywords Social media · Platform · Facebook · Learning · University · Higher educational institutions (HEIs)

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1   Introduction

Technology can be used by higher education institutions (HEIs) to enhance students' educational experiences [5]. Technology can raise the effectiveness of virtual class-rooms, especially those for part-time or distance education system [5]. As a result, a great deal of work examines how social media might be used in online learning. A lack of electronic learning interaction and professor preparedness have been addressed by previous studies that have examined the inclusion of social media in the online learning environment, the establishment of online learning platforms, and the incorporation of social media presence into adult distance learning. Researchers have found that teachers and faculty see technology as an element of lifelong learning, as essential to educational opportunities, and as something that enhances and enriches the course content itself. Additionally, research has found teachers and faculty to be under-equipped to deal with the challenges of online learning due to both, a lack of familiarity with new and rapidly evolving technology as well as a lack of face-to-face interactions with students. Using social media is a way to communicate and collaborate with others online. Social media sites such as Pinterest, Twitter, Insta-gram, YouTube, and Facebook are included in this category, as well as newer ones. When used for educational purposes, social media can enhance communication, enhancing the student experience and improving outcomes, by encouraging inter-action and engagement among students,nurturing a student-centric learning envi-ronment,extending the learning environment beyond the classroom; and facilitating information flow between students, faculty, and the community at large. A dearth of studies on the advantages and drawbacks of social media integration in the class-room in an online learning environment exists despite recent efforts by researchers to promote student engagement and performance through the deployment and inter-action with new technologies. As a result, the goal of this chapter is to identify the most important benefits and problems of higher education's use of social media. This study adds to the body of knowledge about how students use social media platforms to benefit open education, and it stresses the importance of social media in spreading principles of collaborative working and open education around the world. Students and academics alike can benefit greatly from online resources and social media sites like Twitter and Facebook.

2   Literature

2.1   Social Media

The word "social media" (SM) refers to a kind of digital communication that aims to create social networks where users can exchange expertise, data, views, commu-nications, and other types of content [2]. For knowledge sharing and knowledge dissemination, social media is one of the best platforms in the world. It's important

to remember that the younger generation tends to use social media the most. An electronic communication method that allows users to form virtual forums and exchange knowledge, ideas, private messages, and other materials is known as social media [1].

2.2 Using Social Media in HE

In order for students to interact with people from all over the world, educators continue to improve their teaching by integrating technology. Students, faculty, and other members of the campus community may benefit from the usage of social media in higher education, according to current study. Social media sites such as Facebook, Twitter, and Instagram have advantages over more traditional means of communication because most students already know how to utilize these tools. Social media can be used in the classroom or not, but most students have already set up a class-specific Facebook page or Twitter account or used other social networking site to engage with each other outside of class regardless of whether or not their teachers utilize social media. When it comes to professor-student relationships in the classroom, Ledbetter and Finn [13] note that students use SM to assess and reveal the professor's authority as a subject expert. Due to the double nature of structure, social media not only serves as a medium for social connection, but it also contributes to the foundation of norms and resources that may be used to influence the replication of social media-mediated interaction.

Gender variations in social media use have also been studied by researchers. Gender differences in social media use were observed by Gray. Gender variations in social media use were observed by Martin et al. According to the study, girls begin using social media at a younger age and check their social media feeds more frequently than boys. Because of their university micro-celebrity status, smart ladies felt so much pressure to be on Facebook every day that it even caused anxiety in some of them, according to the research. Researchers have shown that there are disparities between men and women when it comes to using social media.

We must remember that social media are more than just "getting online" in terms of their educational value. The use of an LMS to incorporate blended or online components into a course expands the course's flexibility in terms of both time and location. As a result of this, some progress can be made in one's digital literacy. A social media component, on the other hand, allows students "to customize their learning experiences based on their own interests, aspirations, and choices for participation, online communities and social media platforms," thereby increasing the potential value [8]. University administrators are increasingly calling for pedagogical incorporation of social media in the classroom as well. Surveyed secondary school principals in the United States found that 62% of them wanted their teachers to use social media more in the classroom.

2.3   Benefits of Using Social Media in HE

2.3.1   Better Student Participation

The idea of speaking in front of a large group of people you don't know can be nerve-wracking at times [4]. As a result, many shy kids keep their mouths shut in class since speaking up in front of their peers makes them uncomfortable. With the advent of social media, students no longer have to worry about being isolated from the rest of the group, and this reduces their reluctance to share their thoughts and ideas on matters that are up for debate [20]. Teachers and professors are sometimes taken aback by how socially shy students suddenly become when they are placed in an online environment.

2.3.2   Trust

Use social networking platforms in a local, educational context to improve your arguing and discussion skills. This aids students in developing their own personal brand identities. In this setting, personal skills are critical: making, developing, and maintaining friendships, and being considered as a trusted connection in a network are essential. Learning to function in a university, community, public social arena, and as a member of a peer group can all be learned through the use of social networking platforms.

2.3.3   The Use of Social Media as a Mode of Communication

Students and teachers need to communicate effectively. Teaching and learning would be hampered if suitable channels of communication are not available [7]. Students benefit from their teachers' many possibilities for sharing relevant links. Social media makes it possible for everyone—students, teachers, and parents—to communicate in real time. Teachers can keep in touch with parents and keep them informed of their children's progress by using social media sites like Facebook. On the other hand, there are some drawbacks to using social media. Some students may be distracted by social media. Teachers will be unable to tell which students are paying attention because they will be unable to tell which students are being distracted [3]. Students are able to stay in touch with their social circles, academic peers, family members, and even their teachers thanks to the internet. Rather than just passively absorbing information, students take an active role in their learning with this method.

2.3.4 Learning and Networking via the Internet

Traditional learning is a thing of the past, since social networking is pushed on nearly all of the most popular e-learning sites. Using social media is the quickest and easiest way for college students to develop a network. Friends, coworkers, and associates may all be located and reached with ease thanks to social media [17]. E-learning websites like YouTube, Udemy, Facebook, Instagram, and so on allow students to take lessons and debate their doubts via social media [7]. With the help of social media, you may stay in touch with people you might otherwise lose touch with because you don't see them on a regular basis, such old university pals or relatives who live in another city. In the end, social media has allowed students to establish and retain professional relationships [17].

2.3.5 Using Social Media as a Means of Attracting and Retaining Students

In order to keep students engaged, social media techniques might be utilized [3]. Students' attention has been drawn to social media by millions throughout the world,the same thing can be done to draw students' attention to the educational opportunities provided by their universities [7]. There are a variety of social media platforms available for students and educators to share their work and resources.

2.3.6 Demonstration of Originality

Students, as well as teachers, can use social media to demonstrate their abilities and share their thoughts. In addition to images, blogs, articles, videos and audio recordings, students can express themselves in a variety of ways [7]. As a result, students are able to discover their unique abilities, which opens the door to new career possibilities.

2.3.7 Collaboration

The ability to work with others through social media is yet another significant advantage of the medium. Students and teachers can work together to attain a common objective by collaborating intellectually and socially [7]. Users of social networking sites are encouraged to collaborate, think and act as a group. Listening and compromise abilities are also required. Students may need to ask others for help and advice in using services, or understand how platforms work by observing others, particularly in complex gaming or virtual environments. Users will be more equipped to assist others once they have got the confidence to do so in a new situation [1]. Use social media to find and distribute information from both internal and external sources. It's also possible for students to create their own educational materials [7].

2.3.8   The Use of Social Media to Do Research

Social media in education makes it simple for anyone—students or teachers—to locate reputable academic sources quickly and efficiently [7]. A student's education field can be researched on social media sites such as Twitter, Facebook, Instagram, and YouTube. There are numerous instructional Facebook groups available for students to join.

2.3.9   Using Social Media to Connect with Experts

Students can use social media to find out who the experts are in a given field and academic area [7]. As in following famous persons, subject specialists, business tycoons, prominent lecturers, or those in their career sector who they idolize. This means that kids may do everything from chatting with their peers to keeping up with the newest information on the topics of their choice at the touch of a button [17]. As a result, when students follow these professionals, they are able to learn more and gain valuable information. It's a great opportunity for students to obtain help from professionals in the subjects they are struggling with [7].

2.3.10   A Marketing Strategy

Any university event, service, or activity can be promoted through word of mouth on social media platforms [7]. In order to ensure that other students participate in the university, this is how it is done. University art and craftwork can also be advertised on this site [7]. In the future of advertising, social media is a major component of digital advertising. Marketers saw an enormous opportunity in the rapidly expanding social media user base [17]. Additionally, it's a great way to raise money. Dedicated social media advertising efforts are common for many businesses. Numerous online marketing firms that place an emphasis on social media marketing have also emerged [15].

2.3.11   Aids in the Acquisition of New Information

Through the collection of data and information, social media can help students improve their academic performance and knowledge [7]. When students are given assignments, they use various web resources to gather information for their projects.

2.3.12   Updates Regularly

Students, in particular, benefit greatly from the ease with which they can stay abreast of current events thanks to social media. It enables them to keep up with the newest

trends and developments in the industry. Additionally, it allows students to stay in touch with loved ones when away from home for university. Social media sites provide students with an abundance of study resources. It keeps them up to date on the newest technology and news developments. In this way, individuals are able to conveniently stay abreast of new job positions.

2.3.13   Exposure to the World

Every day, students can access a wealth of educational resources via social media, such as educational websites, video tutorials, and webinars. They are able to get a large amount of information from all over the internet with the use of the internet. Those who conduct thorough research can also apply to institutions in other countries, increasing their chances of finding a job and a home abroad. Students can also communicate with their lecturers online from any location in the world, as long as they have an Internet connection. Observe classrooms online, ask for assistance, and engage in discussions with more knowledgeable teachers and professors.

2.3.14   Having Easy Access to Data

Students and teachers can join a variety of online groups based on their academic interests, demographics, university or college location, and more [7]. Student groups can be set up on social media platforms like WhatsApp and Facebook so that students can get the best advice at their fingertips whenever they need it.

2.3.15   Promotes the Use of Innovative Teaching Strategies

Using social media as a teaching tool is also an option. YouTube, Facebook, Twitter, Instagram and other social media platforms can be used by teachers to share educational videos with students throughout the world. Instructors will benefit from international reputation, and students will benefit from the teacher's beneficial resources [7].

2.3.16   Engagements with the Internet

Using web technology, students can collaborate with each other by exchanging links to relevant websites and information. As a result, they are able to exchange personal information and connect with new people right away. Students were able to communicate with teachers more quickly and easily because to the use of social media. Sharing and transferring study-related information is also a simple process for students, who can do so in a matter of seconds. Students who use the internet can post all of their accomplishments and projects online so that others can learn about them.

2.3.17   Encourages Students to Take Charge of Their Own Education

Everything you need may be found on the Internet. Almost anything kids need to know can be found on the internet. Students may find it useful as a learning tool. If children don't have the help of their parents or teachers, they can just search for their lessons online [7].

2.3.18   Enhanced Communication and Literacy Skills

The ability to better communicate via social media is one of the key advantages of the medium. Students can communicate with one another via video calling and normal phone calls on platforms like Facebook, which can be accessed on a variety of devices including laptops, smartphones, and tablets. As we all know, students quickly tire of reading and writing assignments. Students, on the other hand, are more likely to consume online content because of the prevalence of social media. There are an infinite number of things to read in online chats, comments, news, articles, and eBooks. Students will benefit from this in their academic endeavors [7].

2.3.19   Participation by Parents is Essential

Social media allows parents to be more involved in their children's education. A university or college's Facebook or Twitter feed can be followed by parents so that they can keep track of their children's education. Teachers and professors, for example, can use social media to contact parents to discuss or share a student's progress [7]. Additionally, parents can build a network on platforms like Facebook Messenger or WhatsApp and receive updates on their children's universitying. As a result of all of this, parents and universities can simply interact with one another.

2.3.20   Invigorates the Mind

These are just the beginning of the videos to come. These social media sites include a lot of content that might help students improve their creative abilities. The world has a lot to teach us, and the only place we can do that right now is on social media [9].

2.3.21   Promotes Online and Remote Learning

Students may learn from the comfort of their own homes thanks to social media. As a result, some students may not have the opportunity to consistently attend their educational institution. When it comes to distant education, social media can be a valuable resource. With the help of services like Skype, we can hold classes in real

time no matter where we happen to be located. It's crucial to remember that students must be conscious of e-safety, though.

2.4 Social Media Platforms Based on Education Aspect

With social media such as Instagram and Facebook you have access to online conversation and information that is completely free.

YouTube—There's no cost to using YouTube for educational purposes, and students have the option of rating and commenting on the videos they see. In addition to being part of a course, teachers can utilize these videos to broadcast whole tutorials or just a few teasers in order to draw in a specific target audience [22].

Instagram—Among the many reasons students adore Instagram is because of the wide variety of photo and effect options it provides. Students can even build campaigns for certain organizations or just for a class by taking images, uploading them, and then adding captions to them. Teachers can use these assignments to tap into the growing popularity of Instagram among their students.

Facebook—Facebook is a great social media tool to use in the classroom because of the ease with which it can be integrated. Encourage students to "like" the class' Facebook page so that the teacher can publish class announcements, homework assignments, and discussion starters there. If you're an instructor, you can also create Facebook Groups for each of your classes so that you may stream Facebook Live Lectures as well as post discussion questions to the group as well as make class announcements [21]. As an instructor, you may quickly and easily create a restricted or open group where you can share information about a course or module or even an entire page about it. A place where students can openly discuss course-related topics, ask questions, and publish information that may be of interest to each other is available [22].

Google Plus—Circles on Google + allow teachers to connect with their students in a more personal way. If a lesson doesn't sink in the first time, students may require additional instruction. Encourage your students to form their own learning community, complete with the tools they need to succeed.

LinkIn—LinkIn is a business-only social networking site that has shown to be particularly beneficial in the field of eLearning. At the moment, there are thousands of forums and groups in many languages where educators, educators, and influencers exchange ideas, challenges, innovations, and tips on how to do things better and more effectively [22]. Due to the fact that learners and users can actually view each other's profile information and achievements, this social platform has a larger value than earlier social platforms. This usually defines who is the debate leadership, planner, or specialist.

Twitter—It's possible for teachers to use the same Twitter handle for each class year after year, or they can invent a separate handle each time they teach [21]. To assist students stay on top of their assignments, teachers might use Twitter to send reminders about due dates, encouraging quotes, and resources like online quizzes. Teachers can also organize Twitter chats and debates based on a specific hashtag that they've set up for their course [22].

2.5 New Algorithm for Regulating the Usage of Social Medias

Social media has mostly taken over the lives of teachers and students. Users may communicate with each other at any time and from any location via platforms like Instagram, Facebook, and Snapchat, while TikTok and YouTube offer an unending supply of content and amusement [14]. In order to comprehend how their most-used apps may affect their life, consumers need be aware of what happens "behind the scenes." The chapter explores rules that can lessen some of these effects because social media has a variety of risks as well as advantages. In the end, neither social media nor algorithms nor pure enjoyment are terrible. One would struggle to come up with an excuse not to impose some kind of limitations on the use of the three factors (enjoyment, technology and algorithms) combined given the way algorithms are used in the context of entertainment-rich social media. In an effort to create individual going to target safe and moral, the Center for Data Ethics and Innovation (CDEI) [6] is urging governments to regulate social media algorithms created by businesses like Facebook. According to CDEI [6], the government must make sure that the digital hazards authority examines how sites promote content in order to safeguard susceptible people in the end and foster public trust. It is unlikely that mobile phones and social media in general will be banned (though suggestions are not impossible). Thus, controlling the algorithms used to select social media content is the greatest approach for legislation to bring about significant change [14]. Countries must create and implement a public policy platform that governs the digital economy and harmonizes it with the interests of social and democratic integrity. Governments should anticipate and reduce associated risks, such as the possibility of abuse, and audit regimes must be proportionate to the types of enterprises under examination.

The quantity of posts featuring user-targeted contents that appear in a user's feed should be restricted in some way. A user might still utilize search phrases to find a certain type of content or a niche group if they were really interested in doing so [14]. Social media apps should also be governed so that, after showing users content they are initially interested in for a 30-min period, they switch to a more varied selection of postings. This would result in a gradual decline in consumption after a certain amount of time [14]. In order to protect the public from some types of personalized advertising that constitute a threat to society, platforms should be forced to keep online ad archives [16]. It is necessary to scrutinize jobs and other "possibilities" in

order to prevent online targeting from leading to discriminatory practices and age-restricted items in order to ensure that political statements can be viewed and debated [6]. Requirements for mandatory audits and inspections. One of the most important functions of an independent regulator should be to ensure that its commitments are upheld. Only if there is complete openness between the platforms and a third-party regulator will this governance architecture operate. The regulator should be able to demand the granular evidence it needs to carry out its supervisory duties, and should be able to take action when platforms fail to do so.

2.6 The Challenges of Using Social Media in HE

Because every social media challenge is different, the threats that can befall it also varies. Students' reflective practice and decision-making abilities can be honed through the use of "real-life" examples from the world of social media.

2.6.1 Distraction

Students are more likely to use social media for interacting than for academic purposes [18]. The majority of students [18] also believe that social media platforms have a favorable effect on academic advancement. According to the findings of Karpinski [11], students who use social media platforms (such as Facebook, WhatsApp, and the like) spend less time studying and, as a result, earn lower grades than those who don't. According to Karpinski and Duberstein [9], social media platforms (e.g., Telegram, Instagram, Facebook, WhatsApp, and Twitter) remain a big distraction for the present generation. Academic achievement and the use of social media are linked, according to Kubey et al. [12]. Discipline will be required if social and entertainment notifications are displayed in the same area where students are doing academic work.

2.6.2 Lack of Emotional Ties

Students are unable to form meaningful connections with one another as a result of the social media addiction. There is a lack of genuine emotional connection in most of the connections that are formed on social media. As a result, there is a great misperception of how mankind or individuals operate. There will be a large majority of people in the comment areas of posts who are promoting violence and hostility (which, by the way, makes the world look a lot scarier than it is).

2.6.3 Falsely Expressing one's Emotions

Texts and emoticons have taken the place of bodily expressions like laughing and crying on social media. People now use "LOL" or "HAHAHA" to express laughter when chatting on any social media platform, and it has become the new standard. Most distressing, the person in question may not be so much as grinning, let alone laughing. To get the conversation started, however, he/she simply typed that in front of a computer screen.

2.6.4 Interruption

The most significant drawback of incorporating social media into the classroom is the potential for it to serve as a source of academic distraction for students. Students' attention can be diverted by social media platforms like Facebook, which has a negative impact on the learning process.

2.6.5 Addiction

This has both physical and psychological consequences. Using social networking sites for long periods of time may have a negative effect on your mood. Symptoms of anxiety and depression are more prevalent among regular users. We can now see only the highlights of other people's lives, which is a surefire way to become stressed out. A lack of quality sleep as a result of overindulging in this activity is contributing to an uptick in anxiety and depression. Increased use has been demonstrated in numerous studies to have negative effects on the quality of sleep.

2.6.6 Inappropriate Social Media Content Posting

For this reason, social media is banned from universities since it is difficult to monitor kids' social media usage. It is possible for a student to submit content that is distracting or damaging to other students.

2.6.7 Reduction in Academic Achievement

A lack of concentration on learning and retaining knowledge is a result of students relying on this and the internet to offer solutions. Academic performance declines for students who try to multi-task by accessing social media sites while studying. Distractions like this make it difficult for them to focus on the task at hand.

2.6.8 Absence of Direct Exchange of Ideas

It's a common concern among instructors to worry that kids aren't getting the practical skills they need because of the real-time online stream. Students should be expected to be able to effectively express themselves and join with others in order to have healthy personal connections and social lives.

2.6.9 Lack of Control Over Inappropriate Content

Generations are exposed to a wide range of content since they have complete access to every website and social media platform, as well as no adult supervision. There are some threats that are not appropriate for a person's age or community's ideals.

2.6.10 Age-Related Issues

When it comes to news and information, researchers have shown that young people are often unable to discriminate between trustworthy social media posts and websites and those that are misleading or fake. Many students are unable to focus on anything else, such as university work or a future profession, for more than two or three hours without checking and updating their profiles on various social media sites like Facebook and Twitter. Students were found to be using smart phones, android phones, and tablets to have quick access to the internet so that they could join various social media networks. Social scientists have also suggested that a person's future college and employment chances may be harmed as much by a lack of a positive digital footprint as by a negative digital imprint. Since even deleted digital images are typically kept somewhere else, Kasra believes that teenagers need to guard themselves from leaving a permanent record of unfavorable pictures.

2.6.11 Loss of Face-To-Face Communication

Online learning is still distinct from a face-to-face class. Many studies have shown that social media might have a negative impact on students' interpersonal skills. Body language and nonverbal cues make up a large component of a discussion in addition to the words themselves [20]. Students' ability to form social connections in the same way that people do when they are face-to-face may be weakened or lost when they use social media more frequently [20]. Even in video conversations and conferences, a major percentage of body language cannot be adequately conveyed through the medium of video.

2.6.12 Cyber-Bullying

For the final time, it appears that social media has become more hostile. Some people don't just become more participatory because they are less afraid to express what they want because they are less afraid to speak what they want. They have a tendency to use their words in an aggressive and hostile manner [20]. Social media makes cyberbullying or online attacks easy. Because of the anonymity that social media networks allow, these cyber bullies are able to earn the trust of others before terrorizing them. In extremely extreme situations, these attacks leave deep mental scars and can lead to suicide. Social media is rife with slander, threats, and other forms of harassment. To put it another way, students who utilize social media for academic objectives are putting themselves at risk for cyber-bullying [20]. Other cybercriminals can also steal and exploit them as a result. Aside from the fact that social media are an excellent means of bringing people together, they can also serve as an effective tool for bullying. Students are more likely to abuse or bully each other or even their teachers because of social media.

3 Conclusion

The purpose of this chapter was to look into the possible benefits and challenges of social media in the field of higher learning. It has been found that the use of online social networks can have a positive impact on students' education. According to research, students and teachers benefit from using social media to communicate. They can communicate with each other in or out of the classroom thanks to these networks. Students who are shy, scared, or bored can more easily share their thoughts and opinions via social media, which has been found to be an excellent tool for increasing student engagement. Additionally, social media platforms stimulate cooperation since they provide teachers and students with a single location where they can gather together their ideas, examine them with their colleagues, and publish in a way that can be modified. Educators should take steps to ensure that social media is successfully used in the classroom, taking into account both the opportunities and challenges of using social media as an educational tool. Fortunately, best practices and guidelines may help teachers and students create appropriate expectations for utilizing social media in teaching and learning. Students have a lot to gain from using social media, from building business networks to finding work to becoming a source of income. It teaches students to see the world from a broader perspective and to consider issues from a broader perspective. Learning has become more enjoyable thanks to social media. It has elevated classroom instruction above the level of textbooks and lecture halls by promoting dialogue and the exchange of ideas. Education could be completely transformed if social media is properly implemented. It is essential to understand the role of social media platforms in students' academic success if they are to appreciate how they might help them succeed. Those looking to enhance online education or make better use of social media platforms for education

may find the results in the literature interesting. For the sake of enhancing student achievement in higher education, this study suggests that rather than imposing SM on their students, educational institutions should embrace rather than force them to utilize it.

Even if social media can have bad impacts on teenagers, such as a lack of privacy and a distraction from academic work and so on, they can also have positive effects and can be used in the right way. For example, students can utilize social networking sites (SNS) to stay in touch with one another when a classmate who has been absent needs to be kept up to date on current academic content or to join online communities in order to prepare a project. Regulators must keep up with the astonishing rate and scale of algorithm development and deployment. Public supervision of algorithms is urgently required, as are efforts to level the playing field between algorithm developers and the people who utilize their services. Companies' policies, practices, and outputs will need to be examined in detail in order for an algorithm assessment to be successful.

4 Implication for HEIs Management

An increasing number of educational institutions are finding that social media has a positive impact on their classrooms and students' learning outcomes. Students and faculty members alike could benefit from utilizing all of a campus's resources to encourage collaborative efforts between the two groups of students and faculty members. A campus can have and deploy educational tools and materials because of the advancement of technology and invention in the teaching and learning activities. As a way to improve student learning, educators and academics are experimenting with social media tools. A relatively new, but potentially significant, development is the rising use of social networking sites to broaden and deepen one's social ties. This has ramifications for twenty-first century classroom instruction and teacher preparation. According to this paper's main objective, it is necessary to identify knowledge gaps in the use of social networking sites in the teaching and learning process in formal settings, so that subsequent studies can be conducted in a more focused manner. It also serves as a guide for future social networking site research studies.

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The Effect of Social Media Advertisement on Brand Awareness and Purchase Intention on Home Solar Products (A Case of Peg Ghana Solar Limited)

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Abstract The aim of the study was to establish the efficiency of social media advertisement platforms in creating awareness leading to purchase intention for solar powered home systems especially in the retail sector. The main purpose was to determine whether social media advertising possess the prowess to effectively create awareness and influence consumer purchase intention of home solar systems especially in the sub-urban and rural areas of Ghana using PEG Solar Company as a case study. The study therefore examined the effects that social media advertisements about awareness of brand, brand choice, purchase intentions, and electronic word of mouth recommendations. The researcher adopted a descriptive research design. Given PEG's social media population of 11,782, a sample size of 160 customers selected using the systematic sampling technique. Data was collected from both secondary and primary sources, and the structural equation model was used to analyze it (SEM). The results showed that social media ads had a significant beneficial impact on brand recognition, purchase intentions, and online word-of-mouth referrals. The effect that social media advertisements about awareness of brand choice was however, not supported. Some of the recommendations given were that the utilization of several social media outlets campaigns should be an integral part of the marketing strategies of the facilitate conversations, connecting with audience and building relationships to enable the firm respond appropriately to the market. The company should constantly acquire market and customer information through research to ascertain the real factor that influence consumer choice and should ensure that its brands possess the facets of the personality of the brand, including effervescence, expertise, genuineness, sophistication, and roughness. Also, the firm should make its business experience exciting for the customer to generate and sustain a positive electronic word of mouth for the brand on the various social media platforms. Finally, PEG Solar must invest extra efforts and resources to effectively segment and position its brands to serve the rural and the sub-urban markets through innovation and improvements.

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1 Introduction

The rise of social media in the consumer market is undeniable. This platform is mostly used by youthful demographic. It is quickly becoming a "must-have" for companies who engage with customers, and it is becoming a more important element in hiring new and attracting the most sought-after recruits to the workforce from the millennial generation. Social media advertising refers to the promotion of a business's goods and services via the use of social media and other online social networking platforms. Advertisements on social media provide businesses with the opportunity to engage with their existing customer base as well as to expand their customer base while simultaneously promoting their desired values and goals. According to Ghana Business News survey (2019) the number of customers who make one or more online purchases has increased significantly. According to the statistics, a rising percentage of clients have digital devices like smartphones, and middle-class consumers are growing in Ghana, the majority of whom are young, has resulted in an increase in online transactions over the last few years.

There are major issues confronting Ghana's electricity market and Africa at large. First and foremost, there is a serious lack of electrical power or connection to the ordinary citizen. Low electrical permeation is most prevalent in rural areas. Self-sufficient access to power will be extremely beneficial to hospitals and clinics that do not operate on electricity. Vaccines should be kept in refrigerators and more live could be saved. The environmental and social consideration, solar energy is a highly appealing and evolving green energy in Ghana. Ghana's energy commission announced that the country has plenty of solar energy, with regular irradiation levels ranging from 4 to 6 kwh/m^2. It is in this light that this study is set to investigate whether social media advertising can significantly affect the awareness creation and influence of retail and consumer purchase intention of home solar system due to the low electrical energy permeation prevalent in most of the sub-urban and the rural areas in Ghana. The specific objectives for the study include: (1) To determine whether social media advertisement is effective in creating brand awareness; (2) To assess social media's impact on brand choice (3) To assess how social media ads affect purchasing intent; and (4) To determine the influence of social media advertisement on electronic word of mouth (eWOM). The study makes several contributions including: The study will reveal the nature of effect that social media is having in relation to the creation of awareness, purchase intentions, and brand trust of PEG Ghana Solar Limited's home solar system on the Ghanaian market. This information will be vital for the company's strategic planning and social media campaign strategies. It will also help appreciate the benefits of evaluating an emotional response to purchase intent. At this point, consumers will watch, understand and identify how a particular brand can improve their lives. It also hopes to highlight what sets other brands apart from

competitors and how firms can do the same thing differently. It will help unearth the potential customer values such as convenience. Interactivity, excitement and cost saving among others, which are vital for competitiveness and gaining market share for the company the company brought and through the use of social media technology. Finally, it will serve as a reference literature for further study into other relevant areas and aspects of social media advertisement.

The rest of the article is arranged as follows: Sect. 2 deals with the review of theoretical concept and relevant literature on the topic. Section 3 deals with the study methodology, while Sect. 4 takes care of the results and discussion. Section 5 dealt with the conclusion and recommendations of the study.

2 Literature

The Adoption of Social Media Marketing Technology

The concept of adoption has been used in the past to get an improved understanding that contribute to the effective execution of a wide variety of innovative business concepts [5, 21, 34, 39]. A knowledge of the process by which innovations are conceived, as well as of the communication routes that steer inventions, adoption rates, and adopter types, are elements of adoption theory [21]. Adoption rates may vary widely depending on factors such as comparative advantage, degree of complexity, degree of observability, and compatibility. Research on adoption theory has mostly concentrated on identifying particular factors that characterise innovative adopters, classifying adopter variables, and outlining socioeconomic distinctions across adopter groups [21]. It is helpful to comprehend new innovations with the help of adoption theory, as well as the early assimilation of established ideas [21]. In spite of the fact that marketing through social media has been around for some time, the fact that many companies in the landscaping sector either don't use it at all or just use it to a very limited extent makes it an innovative approach [23]. Following the implementation of social media marketing techniques by a company, a number of interactions will take place between the company and its customers [7]. Every economic transaction that takes place between a company and its clients should strike a healthy balance between the company's bottom line and the cultivation of long-term connections [7]. There is a lot of promise in the social exchange theory for increasing mutual gain while decreasing cost [37]. For example, social exchange theory was utilised to examine how social conduct was influenced by this trade process. As a cost-effective way for businesses to build new, long-term connections with their customers, online social networks like Facebook and Twitter are great for social interaction [37]. We employed theories of adoption and social exchange to explain the adoption and exchange process for landscaping businesses included in this research. To better understand the elements that contribute to a successful adoption process as well as those that might thwart it, Lupo and Stroman [22] Journal of Social, Behavioral, and Health Science 213, used their social exchange theories.

Social Media

Since the rise of social media in recent years, firms and brands have had to rethink how they interact with and reach out to their consumers. Marketing channels that currently reach over two billion internet users may now be rapidly expanded, resulting in unprecedented prospects for raising consumer awareness of a brand and, ultimately, influencing purchase choices. Companies are spending a lot of money to build a significant presence on online platforms such as Facebook, Twitter, and YouTube because these channels became more important for disseminating material [12]. Consumers now have a plethora of options for finding out about a company and making purchasing choices based on the information they have access to thanks to the innovations described above [29].

Several years ago, the number of users on social media has expanded significantly, according to Dabbous and Barakat [8]. As of 2018, Facebook has 2.27 billion active users throughout the globe, while YouTube and Whatsapp each had 1.5 billion active users. Because of the increased accessibility and usage of social media platforms throughout the globe at any time and in any location made possible by the annual 100% adoption of mobile phones, this trend will only continue. Similarly, according to UMass Dartmouth data, corporate Facebook use has increased significantly. Due to its rapid growth and broad use, social media, with its online platforms where sharing and engaging in a wide range of activities, is becoming significant means for companies to engage with appealing target groups. Customers' purchasing decisions are influenced in part by social media. 70% of customers have used social media to gather information, according to Kim and Ko [20], and the information that these consumers acquired on social networking platforms led to nearly half of them making a purchase as a direct consequence of that research. Globally, there are currently 3.484 billion social media users, a growth of 9% over the previous year. 45% of the world's population is on social media, according to this figure. Social media adoption has also exceeded prior forecasts, which predicted that 2.82 billion people will be using social media in 2019. While this indicates that businesses may reach wider audiences than ever before, a new trend affects that audience base affects this audience base [26].

Types of Social Media Advertising

Advertising on social media may take many different shapes and forms, depending on the particular platform that is being used. Advertising on Facebook, Google, and LinkedIn, three of the most widely used social media sites, focuses mostly on facilitating social networking. Advertising on other social media platforms, such as Twitter and Instagram, is also prevalent. Video sharing is the primary focus of services like YouTube, Facebook Life, and Vimeo Adverting. The primary focus of Instagram, Snapchat, and Pinterest is the sharing of photographs, while Twitter and Tumblr are mostly used for microblogging.

Importance of Social Media Advertising in 2021

So, in effect, the following are the top five reasons why social media advertising is so crucial for businesses:

- Engaging Customers

Customers are already spending time on social media sites, which is one of the most compelling reasons for businesses to market their products and services via these channels. It is a terrific approach to communicate with clients on a personal level while also engaging with them [25]. It is possible to establish which social network one's target audience use the most by doing even the most basic of market research. In addition, gaining the attention of one's consumers and convincing them to engage with one's brand may be accomplished via communication and interaction with those customers. By doing so, a larger audience may be addressed in real time, which is beneficial for establishing oneself in the market [25].

- **Improves Brand Loyalty**

Customers may locate and connect with a firm that has a social media presence. This will aid in increasing client retention and loyalty. The usage of social media should be included into the business plan of the firm since developing a dedicated customer base is one of the most important objectives of any organisation [26]. Brand loyalty and consumer satisfaction usually go hand in hand. Social media may be used for promotional efforts in addition to introducing a company's goods. A client regards them as service channels via which they may connect directly with the company [27].

- **Increase Traffic**

Utilizing social media platforms has a number of benefits, one of the most notable of which is the fact that it may assist to boost the amount of traffic that is sent to a website. via the dissemination of material through social media. One is encouraging consumers to visit and go through its website in order to get further information. When a user shares more high-quality information on his or her social accounts, that user will produce more inbound traffic while also increasing the number of prospects for conversion [27].

- **Effective Targeting**

Optimizing your website and posting often on a blog are no longer adequate in the modern world of online marketing. Successful companies are more likely to have a strong presence on social media. If your brand is visible, search engines will see this as a hint that your business is important and trustworthy [27]. When it comes to social media advertising, businesses may take use of demographic data and tailor their advertisements accordingly. From demographic data (such as age, gender, income, education, and marital status) to surfing habits and social activity may be targeted by advertisers. To further personalise and enhance relevance, networks are providing enhanced targeting options. As a result, it is almost difficult for any company to

succeed today without a presence on social media. Connecting with consumers and promoting your business is an inexpensive way to do it [26]. Regular changes to the appropriate social media marketing strategy may result in many positive outcomes, including increased traffic and sales, enhanced search engine optimization, and strengthened customer loyalty.

2.1 Ghana Places 9th on Global Social Media Rankings

On March 18, during a workshop in Accra on putting the Budapest Convention on Cyber Crime into practise, Matteo Lucchetti, Program Manager of the Council of Europe's Cybercrime Unit, made this information available to the public. According to him, Ghana is one of the top nine nations for daily social media use. According to him, in 2018, there were one million new people who signed up for internet access every single day. According to what he stated, it equated to 11 people each second. People are spending an average of two hours and twenty-two minutes each day engaging in meaningful activity on social media. Even more devotion is shown to social networks by those between the ages of 16 and 24. They may spend up to three hours and one minute every day using various messaging and social networking applications (Influencermarketinghub.com).

According to research on Ghana's Internet and Telecommunications, out of a total population of 32,732,129, there are 14,767,618 people who use the internet, and the number of internet users is expected to expand by 49.126% between the years 2000 and 2021. It is possible that the fall in price of smart phones and mobile data plans is responsible, at least in part, for the rise in the number of individuals in Ghana who are accessing the internet.

2.2 Purchase Intention

The chance that consumers will be willing to acquire a product within a reasonable time in the near future is referred to as "purchase intention," according to Wu et al. [42]. Usually, it has something to do with the customer's attitude, impression, and shopping preferences. Customers have been found to give their purchasing intentions a lot of thought before deciding whether or not to buy any certain goods [26]. When studying consumer purchasing behaviour, purchase intention is always taken into consideration, and many researchers have utilized purchase intention as a dependent variable to analyze consumer purchasing behaviour influences. Consideration by consumers of purchase behaviour is crucial. when assessing and evaluating a certain product. According to Gosh [14], purchase intention is an excellent tool that may be used to forecast the purchasing process. In addition, researchers have been making use of repurchase intentions for a long time as a tool to aid in the prediction of future buying behaviour. Purchase intention is a term that is used in the context of

recommendations to refer to a user's propensity to buy a certain product that has been suggested to them by a recommender system. It has been shown that when customers have confidence in an online retailer, they are more inclined to make purchases from that retailer [13]. Nilashi et al. [32] came to the conclusion that there is a connection between the faith that customers have in an e-commerce recommendation system and their desire to make a purchase.

2.3 Brand Trust

Brand trust is the most critical aspect of a brand strategy. Consumers must believe that your brand will deliver in every contact or they will look for another. Trustbrand Studies show that brand trust is crucial [9]. It is a key aspect in corporate performance [31]. According to Chaudhuri and Holbrook [4], brand trust is "the typical consumer's readiness to depend on the brand's claimed function." Brand trust emerges when people evaluate company offers. If firms portray their brand as secure, honest, and reliable, customers will trust it [9]. Brand trust is generated through customer brand experiences. Brand trust creates highly valuable relationships [4]. It indicates that brand loyalty is part of a valued and noticeable connection that brand trust creates. Brand trust is a loyalty factor, according to research [3, 41].

2.4 Brand Choice

Brand includes packaging, advertising, customer contact points, and marketing communication. Consumers associate a brand with a product, whether knowingly or not. Brand choice indicates a consumer's propensity to choose one brand over another and adds to brand equity. Businesses must monitor and analyse brand preference since it affects marketing. Brand choice is important for companies trying to attract repeat consumers from their target demographic since it builds awareness and a solid reputation. Long-term brand preference increases sales, profit, and market share.

2.5 Electronic Word of Mouth

Electronic word-of-mouth communication (eWOM) is any good or negative comment made by prospective, current, or formal consumers about a product or business that is shared through the internet. People who meet, chat, and communicate in the virtual world share product or service ratings. Buzz marketing may go viral if the message is compelling or entertaining. eWOM emphasises online person-to-person

communication. Electronic word of mouth gives companies an edge over conventional WOM in that it enables them to attempt to understand what drives customers to post online and to assess the effect of those comments on others. eWOM may be a problem for corporations since it's an element they can't control (Yang 2017). To address this, companies are developing virtual areas on their websites where customers may post comments and express their ideas on the business's product and services. Let's imagine you've discovered 10 enthusiastic bloggers with a thousand-person network. Every time they communicate about your business, their network will know, totalling 10,000 individuals. Your company needs it.

2.6 Advertising and Branding Awareness

Advertising is a method of communication that involves paying for space to market a product, service, or goal. This definition was presented earlier in the introduction; therefore, it is not necessary to restate it here. Advertising, sometimes known as commercials for their abbreviated form, is the real promotional announcement that has the purpose of luring clients who are more inclined to pay for a company's goods or services and convincing them to buy the advertised products [26]. One of the most significant functions that advertising serves is to raise consumers' knowledge of aspects of a product or service, such as the price and the name of the brand. A marketing term known as "brand awareness" describes the degree to which customers are familiar with the name of a certain brand or product [27, 26].

2.7 Purchasing Intention and Advertising

Sellers rely heavily on advertising. It's important for promoting new items on the market. Managers must compete globally to attract customers to their goods and services. Advertising helped prospective purchasers become aware of the company's goods. The consumer's attitude towards advertising helps determine their buying intention [15]. Attitude towards advertising is an essential notion since it influences a customer's response to advertising [24, 28]. Chu and Kamal revealed that social media use affects users' attitudes and behaviour. Users with better brand awareness are more likely to have positive ideas and attitudes towards social media advertising, according to the research. Consumers' social media use. It won't alter customer decisions but may mediate them [38]. Social media may affect brand perception and purchase. It may develop a brand's or product's image and influence customer purchasing [26]. When a customer's social media buddy posts or suggests items or praises a branded product, it impacts the buyer's decision making and brand attitude, hence social media advertising affects consumer brand attitude and purchase intention.

2.8 Advertising Brand Trust

Morgan and Hunt [31] provided evidence that indicated the significance of trust in the process of developing relationships with clients. According to their definition, trust exists "when one party has faith in another party's trustworthiness and integrity as an exchange partner." At this moment in time, trust is being associated with a brand rather than an individual in the form of a product or service. On the other hand, it is well knowledge that consumers may see brands as having personalities [1] and can develop feelings of loyalty toward such brands. Because of this, companies are starting to take on a more human form and may thus be trusted. The researchers Chaudhuri and Holbrrok [4] looked at 107 different brands and discovered that confidence in a brand has a significant influence on a consumer's attitude toward the brand as well as their purchasing loyalty, which in turn leads to a rise in market share and premium pricing. As a result, a consumer's faith in a brand's advertising might result in a variety of advantageous consequences for the brand's owner. Because of this, some businesses have begun to take a more direct approach to building a trustworthy image for their company by using more precise language. For instance, the word "trust" appears in their advertising language.

2.9 Advertising Brand Choice

Brand choice is choosing one brand over another when available. A customer drives brand choice measurements by purchasing particular brands of a product repeatedly. This project's hypotheses include brand choice. Advertisements aren't necessarily harmful, yet many utilise deceptive strategies. Despite how much people disregard them and think they don't influence them, that's not always true. Here's how manipulative advertising works, the issues it causes, and how to fix them. One encounters ads every day, whether on a website, before a movie, or during a TV programme. It's easy to say "they're just ads" since, at worst, they're a bother or disruption. People have trouble believing that advertising is deceptive because we like to think we're in charge. While advertising isn't intrinsically harmful, we would have moved on to brand-building messaging. These memories are established because ads make us feel something, good or negative, and that emotional reaction may affect how we think and our decisions. Most study has focused on internet advertisement frequency versus duration. According to research on social media advertising, accidental brand exposures are kept by consumers, whether they recall seeing the brand name or not. Exposure to the brand increases brand selection when social media participants are presented a later option.

2.10   Advertising and Electronic Word of Mouth (eWOM)

When companies invest in social media marketing, one of the outcomes they want to achieve is increased word of mouth from their customers (eWOM). There is a correlation between increasing word-of-mouth advertising and higher sales [2]. Word-of-mouth advertising is both a cause and an effect of retail sales [10], which leads to enhanced satisfaction with the product consuming experience [18]. It has been shown that exposure to advertisements on the internet increases offline brand endorsement (such as word of mouth), online brand searches, and website visits [16]. These customers are particularly proud of their early adoption product experiences and the trust they've gained via the sharing of their ideas [6]. The inclination of a market expert to share content with their network is of particular importance for social media advertising efforts that have been put into action. The inclination to share product information as a result of companies' investments in social media advertising may contain favourable repercussions in the long run. When friends talk about or support other companies on social media, a company receives another kind of exposure that is more personal. When people discuss brands on Facebook, participants may connect to the brand's page on Facebook by tagging the brand in their own posted material. This produces a clickable link in the participant's post that leads to the brand's page on Facebook. On Facebook, electronic word of mouth is spread mostly via customer dialogues of the sort described above (Fig. 1).

The customer journey to brand choice

The customer moves from an unawareness state and becomes aware of a brand after constant exposure through social media advertisements. This would trigger a purchase intention due to the interest aroused from the advertisement stimuli. However, brand trust would be developed by the positive brand endorsements and recommendations by online word of mouth from trust worthy sources leading to a brand choice.

3   Methodology

3.1   Research Design

The researchers adopted a quantitative and explanatory research design, so as to explain the relationship between the variables. Quantitative was used to test the four hypotheses of the study [17]. Because the human mind is incapable of gleaning the full significance of a big quantity of raw data, descriptive statistics play an extremely significant role in reducing the data to a form that is more easily comprehensible. Most of the time, this research design uses SEM as a tool for analysing data patterns. The study's findings and consequences are easier to grasp when you see the patterns in the data.
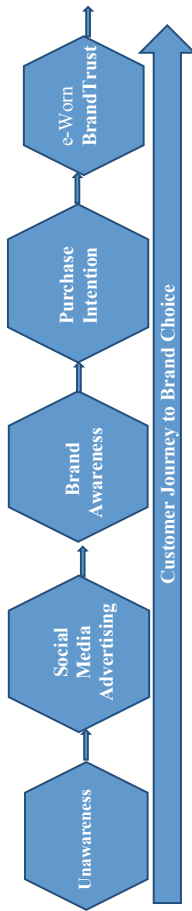
Fig. 1 The conceptual framework of the study

3.2 Population and Sampling

Due to large nature of the population comprising all 11,782 social media customers of PEG solar, the researchers were not be able to cover all the population, hence a sample was chosen from the sampling setting. Researchers use a sampling frame to pick a subset of the population they want to study. Given PEG's social media population of 11.782, a sample size of 160 customers was selected, starting with a random selection, then followed by subsequent selection by a sample interval of 74 from the sample frame of the embodiment of the entire population to be examined, which in this case, comprised the database of all customers who had ever visited PEG's social media platforms. The sampling procedure for this research was the systematic sampling technique. Even though the sample population is selected in advance, systematic sampling is still regarded as a kind of random sampling. This is due to the fact that the periodic interval is also selected in advance, while the starting point is selected at random. The fact that this approach has a minimal potential for data contamination and gives the researchers some level of control as well as a feeling of the process as a whole are the two primary benefits of using it. Systematic sampling is easy to build, execute, compare, and understand. This is of utmost importance for the investigations being conducted since the researchers are working under limited financial limitations.

3.3 Data Gathering Instruments

The data that was used in this study was both secondary and primary in nature, and it was derived from both primary and secondary sources. Primary research is a method of research that entails acquiring data directly, while secondary research is a method of research that entails relying on previously existing data when carrying out a systematic inquiry. Both methods of research are used in the research process. As a result, primary data refers to the kind of information that is gathered by researchers themselves directly from original sources, and then that information is made easily accessible to other researchers so that they may utilise it in their own studies. Secondary data for this project was sought through the review of already existing relevant literature from textbooks, articles, news items and the internet. The instrument used to collect primary data was the use of questionnaires to be administered online to customers on PEG's social media sites.

3.4 Analytical Tools

The structural equation model (SEM) data analysis software was used to analyse, describe the results and also summarize. Analysis involved the use of graphs and charts with percentage to enhance easy understanding.

4 Results and Discussion

4.1 Background Information

Majority (55%) of the respondents were males whereas the rest (45%) of them were females. Three in five (59.4%) of respondents were between 30 and 40 years old, then over 40 years (21.9%), and those below 30 years (15.6%), amongst others (3.1%). Two in three (65.6%) respondents were employees; this is followed by businessmen/women (25%), students/unemployed (6.3%), and civil servants (31.1%). Majority (53.1%) of the respondents were earning between GH¢1000 and GH¢4000 per month: this is followed by those who were earning above GH¢4000 per month (40.6%), and below GH¢1000 Per month (6.3%). Three in five (59.4%) respondents had high or professional knowledge of ICT whereas about 37.5% of them had moderate knowledge, and the rest (3.1%) had low knowledge of ICT. See Table 1 for details.

4.2 Structural Equation Modeling

There are two fundamental steps in structural equation modelling (SEM): evaluation of the structural models and measurement models [17]. The variance-based partial least squares (PLS) structural equation modelling approach used in this work (SmartPLS Release: 3.2.7) [35]. PLS is useful for applying theory because it is flexible and unaffected by data distribution or sample size [17].

4.3 Measurement Model Analysis

By evaluating convergent and discriminant validity, the measurement model studies essentially seek to confirm that the constructs are validated. Some elements, such as "AD1," "BC2," and "PI4", were eliminated during the analysis of the measurement model because of how they loaded into the corresponding constructs. Table 2 displays the factor loadings and bootstrap t-values for the model. All of the Cronbach's coefficient alpha values were over 0.70, which led to the conclusion that

Table 1 Demographic information of respondents

Variable	Frequency	Percent
Gender		
Male	88	55.0
Female	72	45.0
Age		
20–30	25	15.6
30–40	95	59.4
40 and above	35	21.9
I can't tell	5	3.1
Occupation		
Business man/woman	40	25
Civil servant	5	3.1
Jobholder/Employed	105	65.6
Student/Unemployed	10	6.3
Salary		
Below Ghc1000	10	6.3
Ghc1001–GHc4000	85	53.1
Above Ghc4000	65	40.6
Level of ICT knowledge		
Low	5	3.1
Moderate	60	37.5
High	60	37.5
Professional	35	21.9
Total	160	100

the constructs were dependable. Additionally, all constructs had rho and composite reliability values above 0.7. Finally, for every construct, the average extracted variance values were over 0.50. Therefore, the five constructs satisfy both reliability and convergent validity [17].

The Heterotrait-Monotrait ratio (HTMT) of correlations, which was also found in Table 3, was calculated using a criteria of 0.85, and it revealed that all of the correlations were lower than 0.85, indicating that discriminant validity was obtained [19]. Additionally, the Fornell-Larcker criteria for discriminant validity is met because the square root of the average variance derived estimates for each of the five constructs is greater than the correlations among the constructs [11].

Table 2 Reliability analysis and convergent validity

Variables	Item	Loading	Bootstrap t-values	α	rho_A	Composite Reliability	(AVE)
Social media advertisement	AD2	0.512	3.480	0.754	0.898	0.835	0.641
	AD3	0.891	21.397				
	AD4	0.931	30.718				
Brand awareness	BA1	0.638	7.382	0.732	0.770	0.827	0.546
	BA2	0.705	9.900				
	BA3	0.779	11.964				
	BA4	0.821	21.189				
Brand choice	BC1	0.639	2.260	0.709	0.999	0.799	0.576
	BC3	0.693	2.157				
	BC4	0.917	2.038				
Purchase intentions	PI1	0.798	11.379	0.787	0.829	0.874	0.698
	PI2	0.884	23.905				
	PI3	0.821	12.554				
eWOM recommendations	eWOM1	0.793	8.479	0.905	0.998	0.924	0.753
	eWOM2	0.825	9.282				
	eWOM3	0.921	12.726				
	eWOM4	0.925	12.680				

Note All t-values are significant at $p < 0.05$

Table 3 Discriminant Validity-both Fornell-Larker and HTMT criteria

Factor	Fornell-Larcker criterion					Heterotrait-Monotrait ratio (HTMT) 0.85 criterion			
	1	2	3	4	5	1	2	3	4
1. Social media advertisement	*0.739*								
2. Brand awareness	0.360	*0.759*				0.359			
3. Branch choice	0.605	0.457	*0.835*			0.694	0.469		
4. Purchase intentions	0.475	0.189	0.450	*0.800*		0.561	0.222	0.541	
5. eWOM recommendations	0.601	0.645	0.577	0.435	*0.868*	0.729	0.618	0.665	0.377

The italics represent the square root of AVE in cnducting discriminant validity. So, it was seen that the values in italics are greater than the inter-correlation values. hence, discriminant validity was established
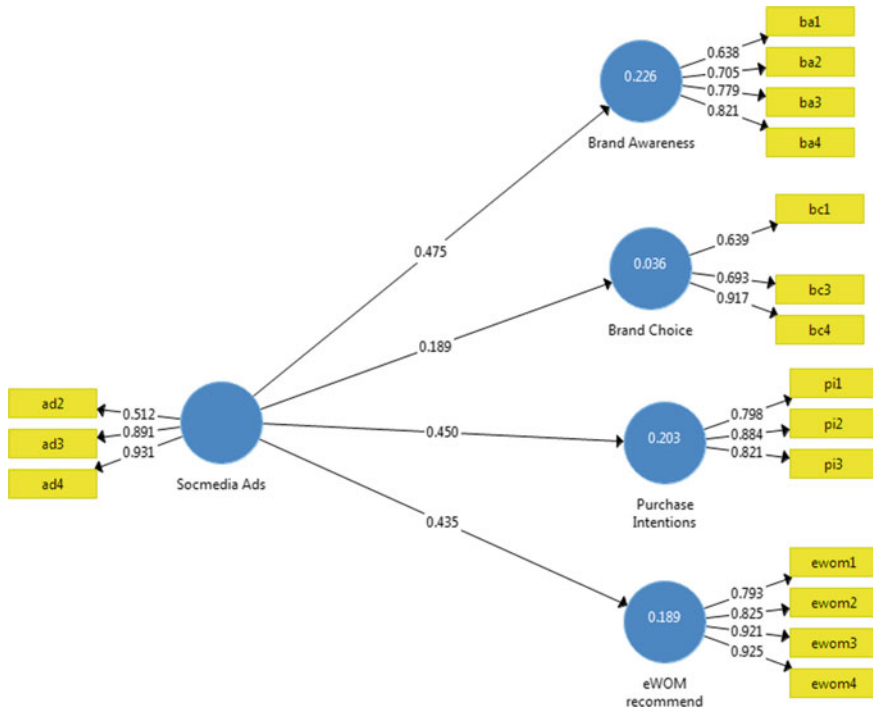
Fig. 2 Relationship between social media ads, brand awareness, brand choice, purchase intention and eWOM-structural path showing path coefficients and items loadings

4.4 Structural Model

This study examines the relationships (if any) between social media advertisements and brand awareness, brand choice, purchase intentions, and electronic word of mouth recommendations. These relationships were tested using bootstrap t-values (5000 sub-samples) [40], a procedure available in PLS. The structural path showing regression weighs and factor loadings are presented in Fig. 2.

The structural paths showing bootstrap t-values are presented in Fig. 3.

4.5 Hypothesis Test Results

The results of the structural including both regression and weights, t-values and hypothesis interpretations are presented in Table 4. Three of the four hypothesis of the study are supported (**H1**, **H3** and **H4**). Comparatively, social media advertisement it's most significant impact on brand awareness, followed by purchase intentions, and
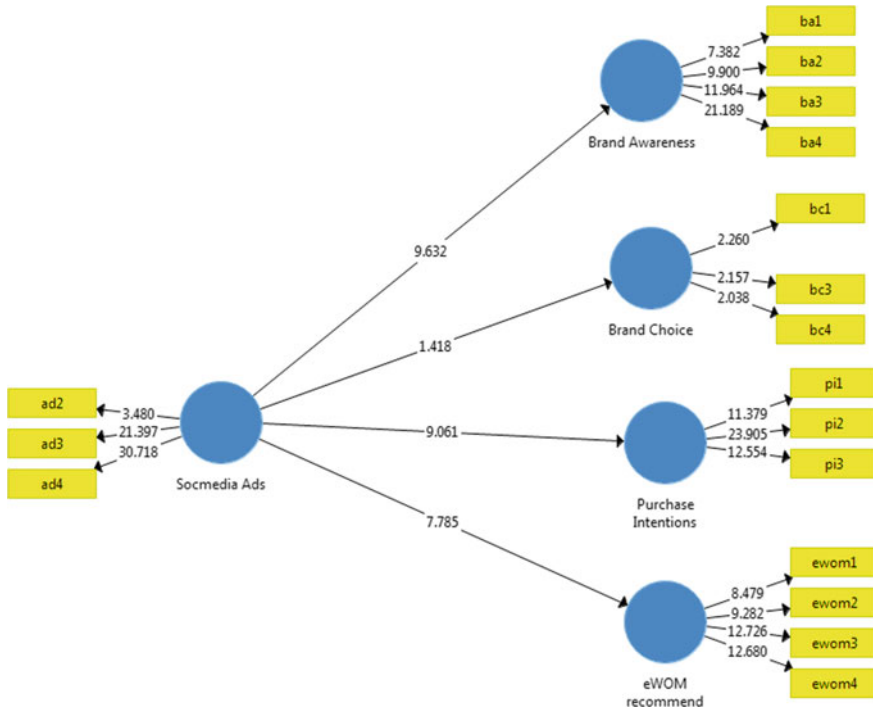
Fig. 3 Relationship between social media ads, brand awareness, brand choice, purchase intentions and eWOM-structural path showing bootstrap t-values

electronic word of mouth recommendations. The effect of social media advertisement on brand choice was however, not supported.

For the investigation, the following hypotheses were investigated: H1: Brand awareness and social media advertising have a large and favourable association. H2:

Table 4 Structural path results

Hypothesis	Path	Path coefficient	t-value	Hypothesis results
H1	SM advertisement → Brand Awareness	0.475***	9.632	Supported
H2	SM advertisement → Brand Choice	0.189	1.418	Not supported
H3	SM advertisement → Purchase Intentions	0.450***	9.061	Supported
H4	SM advertisement → eWOM	0.435***	7.785	Supported

Note ***significant at p < 0.001
Source Field Data (2021)

Social media advertising and brand preference have a large and favourable link. H3: Social media advertising and the likelihood of making a purchase are significantly related. H4: Social media advertising and electronic word-of-mouth have a significant and favourable link (eWOM).

According to the study, social media advertising and brand awareness are positively and significantly correlated with hypothesis 1 (r = 0.475, t = 9.632, p0.001). This supports the claim made in Chap. 2 that one of the crucial functions of advertising is to raise consumer knowledge of the goods or services, including the brand name and price. Because the connection between social media advertising and brand preference for H2 was not statistically significant (=0.189, t = 1.418, p0.001), it is possible that this finding supports the contention in Chap. 2 that individuals see these promotions as an interruption or annoyance. As a result, the second hypothesis (H2) is unsupported in the current situation. The link between social media advertisements and purchase intentions for hypothesis three is favorable and significant (rho = 0.450, t = 9.061, p0.001). According to Chu and Kamal social media use is favorably correlated with user responses, including attitudes and behaviour. This suggests that social media marketing encourage purchase intentions. In light of the current situation, hypothesis three (H3) is justified. The test's findings for hypothesis H4 revealed a significant and positive connection between social media advertising and online word-of-mouth referrals (r = 0.435, t = 7.785, p0.001). Graham and Havlena are completely in accord when they say that social media marketing encourages electronic word-of-mouth referrals (2007). Therefore, hypothesis four (**H4**) is supported in the present context.

5   Conclusion

In conclusion, where as social media advertisements lend support to hypotheses **H1**, **H3**, and **H4**, having its most significant impact on brand awareness, followed by purchase intentions, and electronic word of mouth recommendations respectively, its effect on brand choice was however, not supported, implying that social media advertisement in itself alone does not lead to brand choice, possibly other factors such as brand trust, recommendations by friends and quality may mediate its relationship with brand choice. Hence, it has been proven that;

1. Social media advertisement is effective in creating brand awareness.
2. Social media advertisement influence of on intention to purchase.
3. To determine the effect of social media advertisement alone does not have influence on brand choice.
4. Social media advertisement has significant effect on electronic word of mouth (eWOM).

5.1 Recommendations

Based on the summary and the conclusion above, the following recommendations are made in order to optimize the potentials of social media advertising to remain relevant and competitive. First and foremost, the use of social media campaigns should be an integral part of the marketing strategies of the firm to allow for increased visibility, enhanced awareness creation and user generated content to facilitate conversations, connecting with audience and building relationships to enable the firm respond appropriately to the market. Secondly, since it came to light that social media advertising alone does not influence brand choice, the PEG Solar should constantly acquire market and customer information through research to ascertain the real factors that influence consumer choice of brand such as the physical characteristics of the brand, recommendations leading to brand trust, psychological factors and needs among others and ensure that its brand is among the evoked set of the consumer to improve the brand's chances of being chosen. The firm should ensure that its brands possess the dimensions of brand personality such as excitement, competence, sincerity, sophistication and ruggedness. To improve purchase intention, the firm should ensure to make its business an exciting experience for the customer, offering premiums and guarantees to reinforce good perception, quality and strengthen emotional attachment to the brand. This would generate and sustain a positive electronic word of mouth for the brand on the various social media platforms. Finally it will be in the interest of PEG Solar to invest extra efforts and resources to effectively segment and position its brands to serve the rural and the sub-urban markets by filling the need gab for electrical energy to prevent a competitor from exploiting that need gab. It must innovate and improve its renewable energy products and services in order not to be a sitting target for competitors. Personal selling and educating the segments is a critical success factor.

Suggested area for further studies

Exploring effective marketing strategies to effectively market home solar systems to both the urban and the rural segments.

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Internet of Things and Retail Performance in an Emerging Market: A Qualitative Analysis

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Abstract   Particularly in this digital era, industry practitioners and academics have been paying intense attention to the retail sector's increasing complexity as a result of the internet of things. As a result, comprehending this phenomenon is still essential to the corpus of knowledge. The wheel of retailing concept will be used in this study to examine the internet of things and its effects on Ghana's retail industry. 15 semi-structured interviews were conducted as part of an inductive reasoning technique to analyze how Internet of Things (IoT) solutions were implemented at Melcom to achieve retail success. This publication offers an important perspective on the cutting edge of retail, concentrating on the usage of IoT to eliminate the highlighted obstacles. This research provides a method for effectively "managing and implementing IoT in the retail industry" and improving the quality of service delivery. This is one of the few studies to examine the internet of things and its effects on the retail industry. Its empirical focus on Africa is also distinctive and offers evidence to support the idea that IoT improves service delivery and has the potential to revolutionize the retail industry. As a result, retailers can use real-time data from IoT sensors to identify "product shortages and customer inter-purchase times."

Keyword   Internet of things · Ghana · Retail · Digitization · Melcom

1 Introduction

Digitization has significantly altered the world of trade during the last few decades. The previous "brick and mortar retail systems," in which retail businesses were

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stationed in a specific geographic area selling clients' items and services, have been disrupted by this dramatic and extraordinary transformation [1]. The competition between brick-and-mortar stores used to be focused on their offerings in terms of goods, services, locations, and prices, but that is no longer the case [2]. With the development of the internet, retail business owners are no longer required to sell their wares at a certain point inside a building [3]. Although there are still a number of physical and brick-and-mortar stores that provide retail services, the way that customers and business owners approach service delivery has evolved as a result of digital tools and innovations. Modern consumers have a high level of sophistication and product knowledge, so retailers must be innovative and use digital tools to create a "better customer experience" in order to keep these customers [4].

Retail stores are implementing technologically innovative touch-point technologies (POS, websites, apps, etc.) to provide a "seamless shopping experience for customers in order to increase customer satisfaction" [5]. Customers no longer need to visit retail stores to pick up orders or engage in physical trade, thanks to retailers' better "sales channels and distribution systems" [6]. The way that shops and customers communicate has also been improved by technology. Through digital channels like a company's website and social media accounts, customers may communicate with retailers [4]. All of these point to the fact that merchants' interactions with customers are being redefined by digitization in order to provide better customer service and increase client retention.

The rise in consumer smartphone usage is a major factor driving merchants' digitalization efforts [7]. Customers that use smartphones are able to connect with businesses and other customers globally by using the internet to stay connected at all times. With newer, more advanced models being manufactured and released into the market on a regular basis, smartphone prices are falling [8]. The expansion of the middle class's purchasing power in society is another element influencing the penetration of digitalization into the retail sector [9]. Most members of the middle class are educated, well-informed, and technologically astute. They prefer to shop online because they typically have less free time. Individuals in this category are well-off and have access to a wide range of goods and services; as a result, they do not think twice about purchasing from rivals [10]. They are valued yet tough to satisfy, so retailers are forced to give them digital venues to conduct their business.

The recent COVID-19 pandemic has severely hurt the retail sector in developing nations like Ghana, pushing most retailers to find innovative ways to meet customer demands [11]. The employment of technology in the provision of retail services is costly and necessitates the hiring of specialists to operate them. Because of this, the COVID-19 epidemic had a significant impact on retail stores with tight finances [11, 12]. Therefore, the proliferation of internet retailers poses a serious danger to brick and mortar retail establishments [13]. Faqih [14] Claims that a significant portion of consumers from developing economies prefer internet shopping over visiting conventional retail stores. The retail sector in industrialized economies has matured markets and customers that prefer using digital devices, which has facilitated the current development in online retail services [15], but the same cannot be true for underdeveloped economies. As a result of the current explosion in online retail operations,

Ghana's online retail spending has increased significantly, almost doubling from "14 billion USD in 2019 to 29 billion USD in 2021." The present digitalization drive is forcing retail businesses to change their business models, which has an impact on various areas of their operations. The ambiguity or urgency surrounding the implementation of any firm's digital technologies is one of these difficulties [16]. The implementation of a "digital business model" to improve service delivery is again met with resistance from employees and, to a lesser extent, customers [17].

Investigating the effects of IoT on the retail sector in sub-Saharan Africa with a focus on Melcom-Ghana is necessary for this study. Furthermore, [11] said that the retail sector has not yet responded to consumers' expanding needs in an effective manner. Given that this generation of digital consumers is the greatest generational cohort, researchers must look into how retail companies may use the Internet of Things to please their customers while making a profit. This study also sheds light on how IoT might increase sales for retailers and their management. In order to determine the relationship between the Internet of Things and retail enterprises' performance and the difficulties of retail technological advances in developing economies, the study investigates the elements that contributed to the promotion of IoT at Melcom. By filling in these gaps in the literature, this study aims to advance knowledge of how retail companies might use IoT to encourage the purchase of goods in developing nations. The study specifically looks into three research questions:

RQ1. What are the primary elements that contributed to Melcom's promotion of IoT?

RQ2. What is the connection between the performance of retail enterprises and the internet of things?

RQ3. What are the difficulties with IoT technology at Melcom?

As a result, this research not only makes a substantial contribution to the literature on digital marketing but also offers important conclusions for retail managers. This study examines the effects of IoT on retail performance in emerging economies, going beyond our present understanding of the technology. This study is based on the assertion made by [18] that practitioners of global marketing have a lot to learn from emerging nations. The remaining portions of the article are structured as follows: in the following section, we review relevant literature that focuses on the concepts of digitization, retail, customer experience, and the relationship between consumers and retailers. The methodology in Sect. 3 follows, where it is explained how the research was conducted. Section 4 summarizes the respondents' findings based on the topic areas. A thorough explanation of the results and related literature is provided in Sect. 5. Section 6 follows, which concludes the essay and offers implications for future study, theory, and policy.

2 Theoretical and Empirical Review

This part offers a critical analysis of the study's theoretical foundation and the body of existing research on the notions of digitalization and the "internet of things (IoT)."

The wheel of retailing idea was used to analyze how the IoT has affected retail performance. When describing the stages most retail stores go through on their way from being a little "corner shop to a high-end retail enterprise," the "wheel of retailing concept" is helpful.

2.1 Wheel of Retailing Concept

This idea describes the many phases that some retail establishments experience over the course of their existence [19]. Worrall and Newman [20] asserts that the majority of retail establishments begin as modest discount businesses to draw in price-conscious customers before gradually evolving into department stores for high-end customers. This is accomplished by investing in expensive real estate and cutting-edge technology to boost profits and enhance customer satisfaction. The concept of a "wheel of retail" is divided into four parts, each of which represents a stage in the life cycle of a retail store. The initial or market penetration stage of the retail firm is referred to as phase one of the concept. In this phase, the store maintains a small profit margin by providing a small number of goods and services at a very competitive price [21]. This typically happens because the retail company lacks the name and brand that would encourage customers to pay inflated pricing. The stage of growth is the subsequent phase. The retail company has gained traction since implementing the cheap pricing approach and can now utilize it as a channel to establish the necessary reputation in the market [21]. At this point, the retailer has the option to slightly raise pricing for goods and services, modernize the building it resides in to a higher quality, extend its selection of goods, and provide new services [20]. The merchant starts to focus on other competitiveness that will create market power other than pricing when more customers show a desire to buy more of the retailed goods and services [22]. When a store reaches the third stage, known as the maturity stage, they develop a strong reputation that primarily leads to an increase in client turnover over time as a result of the shop's becoming well-known [22]. The retailer places a lot of emphasis on offering services that will lead to consumer happiness and becomes very concerned with client retention and loyalty. The decline stage, in which the company's fortunes begin to collapse, is the final stage of the retail concept wheel [23]. When newer businesses enter the market and offer better goods and services at lower asking prices, the market enters a decline stage. Some aggressive retail companies also enter the market with better technical advancements that provide consumers with enhanced customer service. Most retail stores that are in the decline stage embark on strategic business initiatives like mergers and acquisitions in an effort to resurrect their operations [24].

2.2 *Empirical Review*

This section offers a critical evaluation and discussion of earlier research on the "internet of things" (IoT), both internationally and in the context of emerging markets. The use of novel instruments that have been digitalized has spread to all industries, leading to various classifications by academics defined as the process of transferring analog information to a digital version by [25] definition of digitalization. In addition to this simple definition, there are more comprehensive ones, with [26] claiming that digitization refers to the utilization of digital assets by organizations to increase efficiency and job performance. Ritter and Pedersen [27] asserts that the notion of digitalization might vary greatly depending on the situation. The transactional and shopping experiences of retailers and customers, respectively, have changed and are still changing in the context of the retail sector [25]. The retail business has evolved over the past 20 years, mostly as a result of the release and uptake of new technology on the market [28]. The abrupt transition from analog setups to digital inventive tools in the retail industry has resulted in a boom in sales for multifaceted e-commerce platforms [29] and caused difficulties for the hitherto successful traditional retail system [11].

2.2.1 The Contemporary Customer

The needs of today's customers and how to meet them with the necessary offers are challenges that retailers throughout the world are grappling with. Modern consumers' wants have evolved as a result of digitization, which has also transformed how they interact with businesses and what kinds of products they anticipate [30]. Additionally, it has empowered shoppers to make informed decisions about the shopping options available to them. Customers today have the power to decide what kinds of retail offerings they want and to influence those selections [31]. This consumer power is demonstrated when customers provide unfavorable comments and evaluations about a company's products or experiences, which have the potential to negatively impact the retailer's overall business performance [32].

2.2.2 Expectations of the Contemporary Consumer

The retail industry is evolving due to digitization, particularly in terms of consumer expectations. According to [33], customer expectations are the collection of concepts or aspirations that consumers have for particular goods and services. Customers always expect their needs to be met; thus, their expectations extend beyond traditional brick-and-mortar retailers to include online retailers [34]. Furthermore, [34] thinks that consumers in industrialized nations are more difficult to please because they expect businesses to go above and beyond in providing goods and services that satisfy their needs. Since consumers expect the same service delivery methods from

small retailers as they do from technologically savvy businesses, this situation has presented challenges for small retailers. The rise in retail companies investing in digitalized, creative tools to boost employee performance and the new generation of tech-savvy customers are setting benchmarks for measuring customer happiness [35]. Through the power they get from digitization, the post-millennial generations are rethinking production and consumption in the context of the retail sector [36]. The preferences of post-millennial generations must be satisfied since they make up a larger portion of the retail customer base if merchants are to maintain competitive advantages in the market.

2.3   Consumer-Retailer Relationship

Forging ties with clients is increasingly essential and unavoidable in today's market, where there appear to be endless competitors to a firm's offerings. Since a positive relationship with consumers breeds loyalty, sustained customer relationships are the pinnacle of organizational growth and success. Retailers may now communicate with both existing and potential customers without geographic restrictions thanks to digitization's provision of the necessary logistics and touch-points. A "touch-point" is any type of channel that encourages communication between retail businesses and their clients [37]. Both verbal and non-verbal touch-points can be categorized, with examples like commercials and posters serving as the foundation for the former [38]. Non-verbal touch-points are essentially the types of emotional ties customers may have with a brand or company. By enhancing their in-person and online contacts with clients, retailers are also enhancing their direct human touch points [38]. To encourage professional and compassionate interactions with customers, retailers are organizing training and educational programs for their customer service staff.

As businesses look for more adaptable ways for customers to complete their transactions remotely, the use of technological touch-points including websites, smartphone applications, and social media accounts is growing. Customers can also provide feedback to producers through these touch points, allowing them to improve and tailor their offerings to their needs [39]. Again, businesses like Melcom in Ghana have created loyalty programs like the Clubcard coupons as a way to thank loyal customers for their consistent shopping by rewarding them. The use of digital tools that track customer purchase history over time has made it easier for retail stores to develop such loyalty programs [40]. The goal of all these initiatives is to improve the interaction between retail businesses and their clients. Consumers' expectations with regard to their relationships with technical touch-points are lower than those with regard to their passionate relationships with human encounters as touch-points, claims [36]. Retailers must employ user-friendly digital solutions to assist them in their routine encounters with customers because interactions with humans have a significant impact on consumers [36].

2.4 Creating Value in Retailing

Both parties benefit from the connections made between retailers and customers during trade transactional operations. Customers buy these items to benefit from the value that businesses have primarily built into their products and services [6]. Value is a relative concept since it might be challenging to determine. Value can be claimed by both the retailer and the customer, but [41] thinks that the customer mostly determines what value truly is in a retail relationship. The concept of value in retail is complex and takes into account the perspectives of both the retailer and the customer. The positioning of goods and services by a retail business for usage and the perceived financial worth of such products to the buyer are both examples of value in retail marketing [41]. This definition supports the idea that in a connection between a merchant and a consumer offering, the latter determines value in the end. Hanssens and Pauwels [42] segmented value into four parts for their study, which included symbolic, functional, economic, and emotional characteristics that represented how important they believed a good or service to be. Understanding value in retail marketing requires a thorough understanding of each of these unique value components. They emphasized how consumers' logical and rational behavior toward a retailer's offerings is related to functional and economic kinds of value. The social and psychological effects that goods and services have on customers, on the other hand, are referred to as symbolic and emotional consequences [42]. Retailers attempt to capture value from customers by continually engaging them and releasing products that meet their demands because there are so many product and service options available to consumers [34].

2.5 Internet of Things in Retail

The adoption and utilization of "Internet of Internet systems" (IoI) is quickly moving to the forefront of modern organizations. The term "Internet of Things" refers to the use of components of any type of technology to assist and enhance business operations between retailers and consumers to promote efficiency and effectiveness in a trading process [43]. The process of exchanging products and services online through intermediaries like computer networks is another definition of the Internet of Things [44]. These definitions show that IoT systems involve more than just online sales of products and services; they also entail customer service and the development of commercial relationships with clients. The definitions of the "Internet of Things" (IoT) alter over time as a result of the ongoing advancement of technologies aimed at enhancing online commercial operations [45].

2.6 Context and Stylized Facts About the Retail Sector in Ghana

Ghana was chosen as the framework for investigating how IoT can affect an emerging economy's retail industry. Numerous sub-Saharan African nations have emerged as having some of the fastest growing economies in the world, according to claims [46]. The Ghanaian retail market is estimated to be around "24.4 billion USD now and 33.16 billion USD by 2024." Foreign and local businesses compete in Ghana's retail market. In 1989, Melcom was a well-known retail juggernaut and the top seller in the nation, with more than 38 locations. Among the many products sold by Melcom-Ghana are groceries, electronics, and home furnishings. Due to the widespread use of the internet in Ghana, Melcom has developed to meet the needs of the current digitization initiative by implementing an "electronic payment system" to serve their clients. Based on this research, this study uses a qualitative methodology to assess the views of Ghanaian IoT users.

3 Methodology

The approach utilized to fulfill the research objectives is covered in detail in this section.

3.1 Empirical Context

We carried out the research in Ghana, which is a developing economy. Thus, Melcom employees made up our responses. The chosen respondents were also Melcom customers who frequently used e-payment platforms to make purchases. Nevertheless, their expertise and area of interest allowed them to offer a wider range of examples of actual events. The choice of context, which was based on the addition of [47], allowed the researchers to have a sample control and, as a result, the capability to successfully and efficiently achieve the specified goal in the sample.

3.2 Data Collection Techniques

This paper focused on in-depth interviews and drew information from existing IoT literature in developed economies in accordance with the research objectives. But the goal of this technique is to accurately capture the participants' perspectives on a given research topic [48]. Boyce and Neale [49] made the argument that this method

provides far more thorough data than is possible through conventional data collection techniques, including surveys. As a result, this qualitative technique assisted in providing an in-depth understanding of the phenomenon based on the respondents' individual thoughts, feelings, and experiences [49, 50].

Customers of Melcom were chosen for the study using the purposive sampling method because they had the ability to voluntarily contribute richly textured information relevant to the topic under examination. The researcher made an announcement to Melcom-Ghana clients who conducted business with the retail store using an e-payment system in order to recruit respondents. The participants chose the photographed subjects from a variety of backgrounds. According to the profile of participants, these include a variety of managers and staff members from both the public and private sectors of the Ghanaian economy (see Table 1). 46 clients in all expressed a desire to participate in the survey. A series of initial questions about the internet of things (IoT) and the retail industry were asked of all 46 respondents "in order to achieve the quality of data and ensure more in-depth data administration and analysis" [51]. Only 15 respondents from the group showed exceptional depth of knowledge of retail and IoT and were therefore chosen for the interview.

The interview lasted, on average, between 40 and an hour. All of the interviews were taped with the participants' consent. To aid in analysis, the tapes were further transcribed. According to [52], the emphasis should be on the quality and richness of the reaction to a social situation rather than the necessity to statistically explain social events. Thus, the study aims to maintain quality and richness while also providing a general indication of the percentage of participants that had a particular viewpoint.

Table 1 Demographic information on the participants

Name	Gender	Age	Profession	Religion
R1	Male	36	Journalist	Islamic
R2	Male	41	Bank official	Christian
R3	Female	32	Entrepreneur	Christian
R4	Male	47	Pharmacist	Christian
R5	Male	29	Teaching	Islamic
R6	Female	33	Self employed	Christian
R7	Female	24	Student	Christian
R8	Male	39	Physician assistant	Christian
R9	Male	51	Consultant	Christian
R10	Male	40	Administrator	Christian
R11	Female	31	Insurance	Islamic
R12	Female	35	Marketing	Islamic
R13	Female	38	Sales executive	Christian
R14	Male	30	Military officer	Christian
R15	Female	26	PRO	Christian

The profiles of participants are displayed in Table 1, where individuals are identified by the aliases R1 through R15.

3.3   Data Analysis

The influence of IoT on Ghana's retail industry was examined using an inductive research methodology. This was achieved by finding trends, topics, and classifications in the collected data. Again, the interviews were taped and written down, and further material was trimmed, compressed, gathered, and organized into themes through human coding [50, 52]. Having said that, the transcripts were further analyzed during the manual coding process, and the "cut-and-paste" technique was utilized to connect related themes with the study objective (i.e., primary codes) and help with the discovery of the research questions. As a result, the conceptual framework, IoT dimensions, gave an idea for the primary codes (i.e., the initial codes), and some subthemes (i.e., the secondary codes) also developed from the data [53]. Individual replies were combined with cross-case analysis in relation to classification to test the comparability of responses, as recommended by [54], until all new units could be kept in the appropriate category.

4   Results and Findings

The primary and subthemes found in the empirical data were recognized, and the outcomes of the findings were organized and presented based on them. The findings' main themes were Melcom's support of digitalization, the performance of the internet of things in retail, and issues with the internet of things in Ghana's retail industry. (Respectively "coded as D1, D2, D3, and D4") The qualitative data was quantified to explain events and viewpoints and to further provide an understanding of the degree to which participants agreed to themes or viewpoints when the results were presented [52].

4.1   Promotion of Digitization at Melcom

Data gathered from Melcom's employees and clients identified a number of variables that support the company's promotion of IoT technologies. Many online retail intermediaries, according to some Melcom employee responses, are to blame for the growth in consumer IoT technology adoption. A participant made the following comment regarding their perception of Melcom's promotion of digitization:

> Since the development of internet technology, consumers are discovering more convenient ways to fulfill their wants for buying. Such clients see that the majority of retailers have created websites and mobile applications for their stores that offer such services.
>
> At the moment, all major stores are forced to use online retail intermediary tactics. Customers perceive these solutions as more affordable because they are efficient with resources. "As you are aware, consumers like brands that will enable them to save money."

These claims are confirmed by [55], who said that internet intermediaries such as e-payment systems are making it incredibly easy and economical to pay for goods and services. Once more, [56] asserted in their study on the effects of online systems on the buying of foods online that online intermediaries are giving clients accessible, less expensive, and more convenient ways to search for and purchase any item of their choosing without having to deal with many issues.

The workers went on to emphasize that Melcom's installation of IoT technologies is significantly influenced by the needs of the customer. Customers in the modern era are erratic and constantly demand that their products be improved. Retail store owners are thus forced to only offer products and services that live up to their expectations. A respondent who works for Melcom stated the following:

> Customers continuously ask producers and retailers for better services at reduced prices. Consumers may modify their buying habits towards certain companies if these criteria are not met. In order to match client needs, brands adopt digital revolutionary solutions at various manufacturing and delivery lines because they do not want to lose customers quickly.

4.2   Internet of Things and Retail Performance

The development of the internet has altered how much work is produced in the retail industry. Additionally, it has never previously seen a closer relationship between retailers and customers. The majority of Ghana's conventional retail stores have been replaced by technology, but they nevertheless provide services that are even better than they once were. Some of the respondents whose opinions were sought out evaluated the connection between technology and its impact on retail performance. A respondent provided the following response when asked about the connection between the two:

> The consumer feedback we offer is improving the services and goods we get from Melcom. Emails, a dedicated customer service phone line, and strategically placed suggestion boxes are all ways that customers can express their opinions and issues.
>
> Melcom's use of electronic channels has strengthened the relationship between the company and its clients. As a result, many customers have developed brand loyalty towards Melcom.
>
> Melcom's use of IoT technology has lessened the strain on our workforce. There are no longer as many customers standing in line to pay for services. The majority of our customers use our electronic delivery and online shopping services.

According to [56]'s research on business delivery in online enterprises, service and delivery delays that were once common in the retail sector have significantly

decreased as a result of digitalization. He continued by saying that quick administration of customer management, service reimbursements, and product deliveries, among other things, is made possible by online application systems.

According to the respondents' responses, it was also inferred that Melcom's use of IoT technologies had resulted in the personalization of goods and services in response to customer demands.

4.3 Challenges of IoT in Retail Sector

In addition to the many advantages that IoT deployments provide for both consumers and merchants, there are additional hazards associated with using IoT as a method of commerce. According to one consumer, one of the difficulties with employing technological solutions is overpaying. She said the following:

> "Irrational purchases are one of the challenges I face while using electronic service systems to purchase." As long as my card allows for such purchases, I am tempted to purchase the majority of the items on show whenever I log in online.
>
> Since I don't typically carry around a lot of cash, I had some degree of control over my purchases when payments were made primarily with cash in the past. But I have countless options to purchase large quantities of goods thanks to the card payment system. Most of the time, I do buy things that I might not use right away or forever.

Wiranata and Hananto [57] asserts that consumers are influenced to make impulsive purchases by the aesthetics of online retail stores, including those in the clothes sector. Wiranata and Hananto [57] believe that retailers utilize social media strategies to encourage impulsive purchases through comments and reviews about a promoted good or service.

Some of the respondents lamented how difficult it is to get people to utilize electronic payment systems because of the high rates of credit card fraud. One of the respondents claims:

> Melcom has serious concerns about the rise in credit card fraud in Ghana. As a result, we urge all of our customers to immediately report any suspect card usage to the card issuer so that they can take appropriate action.
>
> I have seen a couple of my friends and family members lose a sizable portion of their savings to online card fraud. Even though I watch my card transactions carefully, I do occasionally feel afraid.

Rahayu and Day [58] also pointed out that other smaller organizations' inability to completely implement IoT systems inside their operations is mostly due to the investments required to provide IoT technologies.

5   Discussion and Findings

It is remarkable that there is so little literature on the effects of IoT on retail performance given the existence of research studies on the subject. This research adds thoughts from an emerging economy regarding the effect of IoT on retail performance to the literature. Our results support the claims made by [59–61] that the IoT is primarily responsible for enhancing the effectiveness of corporate processes and service delivery. Our results are consistent with academic research on the impact of IoT on business performance. However, research reveals that IoT not only improves business performance through quality service delivery but also provides businesses with innovative solutions for retaining customers, delivering superior consumer value, and creating and maintaining competitive advantage through quality service delivery. This aids in cutting down or stopping client attrition.

Our study also showed that the accessibility of online middlemen is a major force driving the ongoing adoption of new retailing-related technologies. The survey found that modern consumers' use of "mobile applications, websites, electronic payment methods, and credit cards" is compelling businesses to adopt these digital technologies in order to satisfy their needs. Thus, the needs of the customers were another element identified by the research that had an impact on Melcom's adoption of IoT devices. Since consumer demands are ever-evolving, the retail company had to implement systems to stay up with them. Aside from that, Melcom built sophisticated software systems to support its product offerings in order to ward off competition and acquire an advantage over other market competitors. Additionally, it was revealed that IoT channels are cost-effective because machines can be made to carry out human tasks for no additional expense.

It is important to note that digitalization aids in personalizing products to meet customer expectations [62]. As a result, the introduction of digital new tools in the retail sector has reduced the delays that were once linked to the delivery of retail services [59]. However, the acceptance and use of IoT have helped to close the gap between retail businesses and customers, which is supporting the development of positive customer relations. Technology enables businesses to customize their own items without worrying about imitators. This encourages businesses to differentiate their products and service offerings. In addition, the survey revealed that IoT system adoption and installation are expensive because they demand significant capital expenditures. Some Melcom customers also expressed concern about online shopping-related impulse buying behavior.

Practically speaking, this study supports the revelation of the respondents that the bottlenecks that made consumers hesitant to use the electronic payment system at retail stores included impulse buying, online card fraud, chargeback's, user experience challenges, challenges with the "online payment gateway," low internet bandwidth, recurring billing, accrued costs, and disputed processes and transactions. This clearly demonstrates that businesses in sub-Saharan Africa are not customer-centric and lack the knowledge to address customer concerns with a reliable online payment solution that will overcome all obstacles.

6   Conclusion

This study looked at how the internet of things (IoT) affected "retail performance in an emerging market." According to the studies, digitalization is the future of the retail sector if businesses are to match consumer aspirations [59, 62]. Consumers today are picky and expect timeliness in many areas of their lives and in business transactions. They want immediate feedback, want consistency in their dealings, and they look to the internet as an authority. They also want limitless options and total control [59–62]. The study adds to the body of literature by outlining some of the difficulties users of the "online payment system" encounter. It was also discovered that, even though today's consumers are getting harder to please, using technology to produce, distribute, and deliver goods and services is much more efficient than doing so the old-fashioned way.

Practically speaking, this study supported retailers' use of digitisation to offer better products and services to satisfy client requests. Despite this, retailers in developing nations and elsewhere might use the results of this study as a framework to build their services to fulfill the needs of their customers. Ghanaian data suggests that the retail industry has adopted the internet of things. Our research has limits in terms of its reach and depth despite our attempt to shed light on the much ignored phenomenon of the adoption of IoT, particularly in developing contexts. Consequently, generalizing is still difficult because this study is completely qualitative and has a small scope. A quantitative investigation that covers a greater geographic area in Africa may therefore uncover more nuances.

6.1   Implications for Research and Theory

This study focuses on examining the "impact of the internet of things on retail performance within the setting of a developing country" because earlier research has focused on the internet of things and consumer involvement in the retail sector. IoT has changed the game in the retail industry, specifically by improving service delivery and enabling retailers to use real-time data from IoT sensors to identify inventory shortages and customer interpurchase times. According to the research, IoT improves consumer experience, lowers fraud, improves data analytics (which looks at market trends, product turnover rates, optimizes product positioning, and learns about shifting client tastes and preferences), inventory management, etc., according to the research. The study also found that IoT retail managers create "customer relationship management (CRM) systems" and implement marketing and/or promotional strategies. On the other hand, more research is required to examine how IoT affects customer retention. Such a study could produce insightful theoretical information on IoT.

6.2 Implications for Practice

In terms of application, this article provides insight into how the internet of things affects retail performance. The study provides management of retail stores with advice on how to interact with customers and provide prompt service. Despite this, retail establishments in developing nations can use the findings of this study as a guide to provide clients with high-quality services that are delivered quickly. Again, the research draws conclusions that are important for digital marketers in emerging markets to adopt and use IoT technologies for their companies' operations.

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The Impact of Social Media on Consumer Purchase Behaviour

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Abstract The telecom industry is highly competitive, necessitating technology-based strategies to engage and sway people in favor of the brand. This study aims to examine how social media affects consumers' purchase decisions. The results could aid firms in better comprehending the potential uses of social media. A company's social media strategy and tactics to promote client purchase behavior may be built using the variety of social media activity results. The study used quantitative techniques to gather data from 300 Ghanaian telephone industry customers, the majority of whom were located in the northern region, using a correlational design and a convenience sample strategy. It was shown that social media marketing and customer purchasing behavior are closely related. Businesses must comprehend the extent to which both company-generated and user-generated content has an impact on consumer purchasing behavior since social media content can affect how consumers behave while making purchases. This is due to the potential influence of social media content on customer purchasing decisions.

Keywords Ghana · Social media · Consumer · Purchase behaviour

1 Introduction

As a medium of communication in the early 2000s, blogs replaced other less successful social networking ventures [40]. A wide range of "social media communication tools" were readily available during the 2010s [40]. Social media has developed from My Space's social connection in the 2000s to Facebook's adoption in 2006. It now serves as a social platform that enables business executives to communicate with clients [40]. The exodus and change in "social media platforms" may be witnessed

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in the 2007 transfer of MySpace users to Facebook [40]. People may now communicate with one another in ways that were before inconceivable, thanks to social media. Social networking services like "Facebook, Twitter, YouTube, Google+, and LinkedIn," to mention a few, enable regular user connection and participation [60]. Social media allows users to connect with people worldwide and engage with them to exchange ideas and perspectives [60].

Many owners of small businesses lack the expertise required to carry out an effective social media marketing campaign [3]. In this study, we examined how business executives use social media to boost their bottom lines. A viable possibility is for company executives to use social media to expand their current marketing strategies and increase brand awareness [46]. The performance of some businesses suffers when they don't have a social media plan [38]. A cheap method for connecting businesses and consumers is through social media sites like Facebook [42]. "Social media marketing" is an economical option for small business owners who want to boost profitability. Some entrepreneurs of tiny businesses are not familiar with social media. The lack of a "social media marketing strategy" by about 62% of small business owners has a negative effect on sales revenue [1]. Most business executives can afford to use social media marketing strategies [56]. Some small business owners are losing money as a result of their ignorance of social media. The results of this study could help business executives better understand how to use "social media marketing" to build brand recognition, client connections, and income.

Around the world, there have been major advancements in internet technology over the past ten years. Because of how swiftly internet use has spread, businesses have been able to benefit from it and even increase those benefits by using online business tools [20]. Internet commerce increased access to more goods and services, but it also created a barrier to useful client input by only permitting communication in one direction. This barrier was soon overcome with the advent of social media through Web 2.0, which allowed for the usage of a variety of "user-generated interactive tools and communication techniques." Consequently, the issue was promptly fixed. Throughout Ghana's history, the mobile phone sector has served as a secure refuge for social media marketing. By the end of 2020, according to [61], there will be more than 1.2 million social media users in Ghana. The three biggest players on the market right now are Econet, Netone, and Telecel.

These companies are in severe battle with one another for market share and consumers' attention, and as a result of the competition's escalation, the marketing environment has turned into a "red ocean". As a direct result of this, social media use was regarded as a wise strategy for expanding the reach of the competition and learning more about the behavioral intent of consumers. Even though all of the companies in Ghana's mobile phone market have made substantial efforts to add value through social media, the impact of social media on customer behavior is larger than it has ever been identified through scientific research. Given the regularity with which negative social media posts are shared on a daily or nearly daily basis, the impact of social media marketing is becoming increasingly apparent. The speed with which people update their profiles on social media websites is also concerning. According to [43], users of various communication channels transmit, on average,

10,000 social media messages per day. Other customers are significantly impacted by these signals, and this impact might be positive or negative. One of the most urgent difficulties facing social media marketers working in Ghana's mobile phone industry is turning "likes" on social media sites into actual sales. As a result, the goal of this study is to find out how social media may be effectively employed in the mobile phone sector to boost the desired types of purchase behaviors.

In light of the aforementioned, the study's goal is to investigate social media's influence from a more comprehensive standpoint. This ultimately led to the adoption and modification of the social media paradigm created by Poturak and Softic [50]. User-generated content and corporate-produced content are the two main elements that define the success of social media, according to the paradigm put forward by Poturak and Softic [50]. However, factors relating to word of mouth were included into the intended research. Gizlan and Mertucalis's study was a factor in the decision to include WOM variables in the model.

This study examines the interactions between social media marketing variables such as consumer purchase intention (CPI), word-of-mouth (WOM), firm-generated social media communication (FCSMC), and user-generated social media communication (UGSMC). The antithesis of user-generated social media communication is firm-generated social media communication, or FCSMC. Then, to check for any gaps in the research, we carefully review the pertinent literature. As a result, a theoretical model is created in which various components of the SMM function as elements that encourage clients to make purchases.

2 Research Objectives

The major objective of this study is to determine how social media can be utilized in the mobile phone industry to assist consumers in making purchases.

2.1 Specific Research Objectives

The major goal will be achieved thanks to the specific study listed below.

1. To determine if there is a direct, meaningful, and favorable relationship between FCSMC and customer purchasing behavior.
2. To determine if UGSMC and customer purchase behavior have a direct, significant, and favorable link.
3. To ascertain whether there is a direct, important, and favorable relationship between customer buying behavior and WOM.

3 Significance of the Study

The study was required due to the paucity of literature on how social networks affect young consumers' purchasing decisions. The study's objective was to ascertain the impact of social media on young people's purchasing behaviors in the Tamale Metropolis.

This study will advance our understanding of how young people's purchasing behaviors are influenced by social media. Future academics who wish to do research on this topic will find the research findings helpful. This study would also become part of the many journals that have been written about this topic. The research also helps marketers understand how social media impacts customer purchasing behaviour and how firms must utilise social media to accomplish their stated goals. The findings from this research may be important to companies since they may give a deeper knowledge of the issue, allowing for more applicability. Business leaders may also utilise the data to use social media marketing methods to enhance their firms' success rates. The study's results may also improve corporate practise by revealing the most successful social media marketing techniques. The data might help business owners define social media marketing objectives. Learning from company leaders who have utilised social media marketing to encourage consumer involvement may improve business practise and boost local economies.

Marketers will learn from this research that today's consumers do not pay as much attention to advertisements as they used to, and that social media has given companies more cost-effective ways to interact with the general public, from responsive advertising and linked social networks to survey integration as part of a brand's consumer experience.

4 Literature Review

4.1 History of Social Media

The survey found that customers' online interactions were formally limited to shopping and reading. Fortunately, significant Internet developments have given these activities a new level of significance. According to Voramontri and Klieb [67], the emergence of Facebook and MySpace as social networking platforms in 2004 and 2003, respectively, contributed to the phrase "social media" becoming well-known. The co-founder of the Guidewire Group in San Francisco, Chris Shipley, was heard using the term "social media" for the first time. This idea incorporates every apparatus empowering communication online and supporting participation and collaboration. The author's research was inconsistent with [6]. Who revealed that advancements such as corporate and individual blogs, social networks, professionals, social bookmarking and cyber worlds, can be considered within the social media class? Users

can now, without the need for professional skills, be able to develop and distribute content,

Social media can be seen as an upgraded Web 2.0 idea that applies to second-generation World Wide Web-based online services, such as forums, podcasts, social networking sites, and venues where it is possible to connect online. Web 2.0 is a contemporary Internet ideology that emphasizes connectedness and interactivity and enables simple, cost-free information transmission Bayazit [6]. The concept was consistent with Wilson et al. [70], who defined Web 2.0 as characterized by interoperable, user-centered tools and services that encourage social connectedness, media sharing, user-created content, and collaboration between individuals and organizations. Though for some people, the term "Web 2.0" refers to technologies like web diaries, wikis, web recordings, and RSS that make life easier. These developments make the internet more social [25]. Web 2.0 made it easier for users to respond and communicate with others about their ideas. People will make decisions on their own in today's society based on the information they have access to. This affects the strategies firms employ when disseminating information to customers. With the advent of Web 2.0, businesses no longer have control over how they display themselves to customers. Businesses today need to be in touch with customers directly in order to monitor their brand. According to the author, this includes anyone who utilizes the Internet for bilateral contact Bayazit [6].

According to the OECD, user-generated content (UGC) is online content created by end users that is available to the public and should have been created outside of professional practices and without consideration for the commercial market [29, 30]. UGC might be an individual's viewpoint on a topic or it might be a commercial good or service, which could lead to a misunderstanding of the content's originator [67]. In the light of these definitions of Web 2.0 and UGC, social media may be described as a network of internet-based applications that strengthen Web 2.0's theoretical and technological foundations and enable the creation and dissemination of UGC. According to Kaplan and Haenlein [29] Social networking, blogs, user groups, and Wikipedia are all examples of social media (Facebook).

4.2 Social Media

People are able to avoid feelings of rejection and loneliness by engaging in online communication with groups that share their perspectives and welcome their contributions in the form of comments and articles [19]. People are more likely to respond to information that is consistent with their beliefs, but they will not speak up if there is disagreement [19]. People have the ability to express themselves, make connections with others, and garner support all while conveying a message via the usage of social media platforms. The social aspect of being part of a network online is more important to some individuals than the educational component, which is seen as offering value addition. The increasing need for knowledge and information is a reaction to the declining number of customers who want to reduce their engagement in

social media [15]. Social media may influence a person's decision-making processes depending on their culture and the type of internet platform they use [9]. Because of their involvement, engagement, openness, debate, community, and connection, customers wield power on social media, which enables businesses to devise methods to satisfy their requirements and increase sales [48]. In light of social media's rapid growth, marketers are finding it more difficult to see the strategic forest through the trees [52]. In order for businesses to effectively use social media as a medium for marketing and promotion, they need to have a well-thought-out strategy. Social media is the kind of media that is expanding at an unprecedented rate [54].

Leaders must grasp the culture and individual preferences to communicate effectively [71]. Social media is a medium for social and educational communication online. Personal and professional internet connections raise security problems. Sharing information on social networks might be dangerous. Leaks are a social media difficulty [36]. Uncontrolled communication is another problem with social media [36]. Organizational leaders should regulate pre-approved social media material to protect personal information [28]. Social media may have a positive influence on a firm if employees are open to new ideas and willing to try new platforms, even if they fail [12].

Technology was and still is a component that has affected the behaviour of consumers, and in order for companies to make sales and satisfy customers, they need to adapt to the changes that technology brings about. At one time, advertising could only be done on a select few mediums, such as radio and print media. However, times have changed. In today's market, brands and advertising agencies invest a substantial amount of money in platforms of this kind. On the other hand, it was only recently recognised that these media do not support two-way communication, which is now a need for businesses [59]. The phrase "social media" refers to a variety of Internet-based applications and websites that allow users from many different demographics to communicate with one another and share user-generated content, ultimately creating a complex social structure [31]. In the modern era, social media has evolved into a forum that allows for two-way conversation and gives users the chance to write evaluations and comments. This is one of the most important justifications for why businesses should use social media to interact with their customers. Facebook, Instagram, Twitter, and Snapchat are just a few examples of the numerous platforms that millions of people use for social networking [22]. In order to further their objectives, brands have also used social media to target particular demographics. There is proof that businesses successfully position and target their products in the market [62, 27].

5 Types of Social Media Communication

5.1 Firm Generated Social Media Communication

It is the company's responsibility to publish and post on its social media pages, and this is known as "firm generated social media communication" [50]. According to [8], corporate created content is any material that the corporation puts on its social network. This notion that firm-generated content originates from inside the organisation is shared by [8] and Poturak and Softic [50]. Most of the time, the company's social media profiles are managed by the Marketing and Public Relations department. Product updates, new releases, commercials, and other firm-generated media are examples of firm-created content [35]. Being run by the Public Relations department, this section focuses on how stunning the firm and its goods are. On social media, companies seldom criticise their own activities [50]. Poturak and Softic [50] claim that a link may be found between the social media content created by a company and the purchase intentions of its customers. According to Poturak and Softic [50], the two variables have a direct positive correlation. However, in general, Poturak and Softic [50] determined that material created by companies for social media is deemed legitimate and educational since it is created by personnel who have received professional training. This was discovered by [53], who found that official evaluations provided by the firm were predictive of customer purchase intention and behaviour. The firm-generated information, however, is self-reflective, according to Likula, and hence cannot be trusted to reconcile the competing viewpoints of actual product performance and marketing sentiment. An organisation should only share the positive aspects of its goods and services and should never post anything bad about them, according to Likula's rationale. Ndurura [43] cites this as a cause, arguing that firms do not want to expose their dirty laundry to the public via goodwill management. Kulimula [35] draws the following conclusion in light of this data: a little but statistically significant capacity of firm-generated communication to promote consumer purchase intention has been shown to exist.

6 User Created Social Media Communication (UCSMC)

Content that is posted on social media platforms by end users is referred to as "user-created social media communication" [50]. On the company's social media profile, you can find these social media posts made by specific users who are clients of the business [8]. They show how customers and social media users respond to content shared by a business's social media accounts [35]. There is user-developed social media available on the company's social media website, which is being considered. Communication via user-generated social media frequently takes place as a direct result of responses and comments from customers rather than being sought by the organization.

According to [11], consumers participate in the creation of content for a variety of reasons, such as self-promotion, intrinsic enjoyment, and a desire to change societal perceptions. The growth of online brand communities, such as social networking sites, has contributed to the rise of user-generated social media communication [50]. User-generated material is thought to have an impact on consumers' purchasing decisions. Social media content created by people rather than businesses is more likely to persuade other users to adopt a particular action [21]. According to [35], when it comes to the interaction between these two, the perspectives of customers are more reasonable and impartial, making them more instructive throughout the purchasing process. Kulimula [35] contrasted user-generated material on social media with content produced by companies.

Some researchers, however, contend that user-created communication may not be genuine and may fall short of the level of trustworthiness that customers need. User-created content may be driven by competition, according to [43]. The company's goods and services might be criticised by competitors who pretend to be customers and write unfavourable evaluations. Customers on the same channel of the social networking site may regard it as user-generated content, but it is really a message from the competition. However, [35] and Poturak and Softic [50] supported [43]'s claim that user-created material has a large and beneficial influence on customer behaviour, notwithstanding Ndurura's criticism. Ndurura [43] claims that "user-generated content" is the most reliable indicator of customers' intent to buy as a consequence.

7   Social Media Word of Mouth

On social media, "word of mouth" describes unofficial conversations between users who are not sponsored or affiliated with a brand. These comments may be about the firm in either a positive or negative light, and they travel quickly from one user to the next [51]. It is due of this that they are sometimes referred to as "viral communications" [10]. A company's goods and services are publicized through other social networks. As a result, it can successfully spread good news to its other clients on a variety of social media sites. According to [26], positive viral communication relates to good "word-of-mouth," and "negative viral communication," to bad word-of-mouth. Although marketers frequently aim for positive viral communication, other times businesses have developed creative marketing messages that can spread via "positive viral communication" [45].

As a result of Web 2.0's support for social media [23], word-of-mouth has a significant impact on consumers' purchasing decisions. Customers' trust in their peers in social networks, whom they perceive to have many of the same values, has a significant impact on their purchasing decisions. Gros [23] asserts that word-of-mouth marketing significantly affects consumers' purchasing choices. According to [23], more consumers are using review and opinion services like Epinions and TripAdvisor because they consider their peers to be reliable. Kulimula [35] recommends that

corporations keep tabs on what their customers are saying online. Given the rapidity with which information is disseminated, this is a wise move. Firm-generated communication must be sent in order to encourage positive user purchase intentions in the event that customer feedback is unfavourable.

7.1 Consumer Behaviour

Consumer purchase intention is the probability that a person will purchase a specific good or service in the future [73]. The likelihood that a buyer will make a purchase is helpfully predicted by their purchasing intent. A particular action is more likely to be taken than not in accordance with a consumer's desire to purchase [39]. Buy intention, according to Alnsour and colleagues, is a consumer's likelihood of making a future purchase of a good or service and is influenced by their attitude and preference. According to [2], if someone has a high level of consumer purchase intention, they are very likely to purchase the goods the next time they need them.

Recent advancements in digital technology have had a direct impact on how consumers behave, which has resulted in significant change [7]. The result of this is that the person's concept of self has changed [37]. The idea of the self included aggregate cores that included the family, neighborhood, and country in addition to an inner core in the late 1990s [7]. As a result of these thoughts coming together, the researcher was able to create the concept of an expanded self. The enlarged self may be broken down into many main categories, including the physical body, one's mental processes, thoughts, experiences, and the objects to which one feels attached. Each of these ideas has been rendered obsolete by the rise of digital technology, and it is necessary to revise them in light of these developments [7]. In order for businesses to develop marketing strategies that are tailored to the needs of digital customers, it may be beneficial to update and modify some of the concepts that are associated with the extended self. The idea of dematerialization is the first thing that marketers need to take into consideration in relation to the extended self [7]. Words, dates, videos, and music are basically immaterial and invisible in the digital age unless individuals choose to access them. This is true whether or not they are digitally stored. What was once a solo job of information collecting has now become a cooperative endeavour, with shared excitement spreading across a made-up community. However, the question of whether or not digital things have the same value as physical belongings is still up for debate [7]. Due to the fact that data can be replicated, digital products are not unique; nonetheless, despite this fact, they still have value since people miss them when they are not available [17]. Despite the fact that digital commodities are almost on par with the value of tangible items, they are not the same [7]. The uniqueness of digital goods is diminished by the ease with which they may be copied, but the value of equivalent physical objects is enhanced by the fact that each has particular traits that set them apart.

According to [66] behavioural intention predicts actual use behaviour. To find out if there was any correlation between behavioural intention and actual use, Ogut

reviewed all 450 studies in the field and discovered that there was. Purchase intent was used by several investigations as an independent variable [11, 18]. For this reason, purchase intent may predict actual consumer behaviour, which is why this is the case [18]. Positive or negative purchasing intentions may be influenced by antecedents that have a strong impact. An increase in market share may be achieved through fostering positive feelings toward the service provider and encouraging customers to make purchases from that supplier (2013). Instead, customers with unfavourable purchase intent show a significant risk of switching brands, unwillingness to make a purchase from a service provider, and a lacklustre reputation among their peers. Accordingly, [47] came to the conclusion that one of the most crucial elements in a company's performance is its ability to foster favorable and positive purchase intentions among its customers.

8 Main Theory

8.1 Resource-Based View (RBV)

In 1959, Penrose came up with the RBV of the firm as a way to think about a company's resources and capabilities. He said that these things could help a company make more money. When business leaders use RBV, they can figure out some of their resources. The theory's dynamic capability addition turns skills into capabilities based on each person's competences [33]. Arndt and Pierce [4] say that Nelson and Winter came up with the idea of dynamic capabilities in 1982 as an addition to the RBV that was already in place. The idea was to add change and innovation to organisational resource patterns and knowledge. Researchers like Gupta et al. [24] use the RBV conceptual model to look at firm resources as a set of assets that define the business. This helps them come up with marketing plans that will give them a long-term competitive edge. By looking at the organization's strengths and weaknesses, it might be possible to find resources that can be used to their fullest potential and make money. When business leaders use the RBV theory to make plans that will affect their performance, they look at the strengths and weaknesses of the organisation [24]. Barney [5] says that a company's RBV should stress how important it is to improve its internal strengths, evaluate its weaknesses, limit its exposure to external risks, and find opportunities for a long-term "competitive advantage."

By making effective use of the resources provided by their organisations, leaders in business may provide their enterprises with a competitive edge. Executives of companies who apply the principles of RBV theory to their business strategies are able to obtain data on the rewards and obstacles that their approach presents. Using RBV ideas, executives in businesses are able to identify both their existing resources and the areas in which they may develop. One of the advantages of using the RBV conceptual framework method is that it gives users the ability to concentrate on organisational planning resources and the ongoing improvement of their performance. Another

advantage is that weaknesses in the operational process may be identified, and either outsourcing or collaboration with other organisations in the form of service exchanges can be suggested as potential solutions to assure the organization's continued success in the long term [16]. When company executives have determined the resource needs of their firm, they may evaluate the benefits and drawbacks of their marketing plan [24]. Small business owners who use RBV may find both physical and intangible instruments that might help them achieve their financial objectives. Social media is one of the resources offered to business owners for use in their marketing initiatives. If done so in accordance with a thorough plan, using social media as a marketing technique may boost revenue.

The inability of RBV's corporate officials to adjust quickly enough to the rapid changes in the market, especially in terms of technology, is one of the company's problems [65]. According to the opinions of the executives of companies that utilise RBV, some resources, such as the capabilities of a company's personnel, may not be reliable if they cannot be reproduced or increased [65]. For the sake of running a business, an executive's resources may be broken down into two categories: the individual's expertise and experience, as well as the company's brand [63]. Business leaders may develop ways to strengthen their competitive edge with the use of organisational resources that represent either the advantages or the problems of their company. The term "resources" refers to both actual and intangible assets owned by the firm. RBV is a notion that takes into account both the physical and intangible assets and capabilities of a business [74]. The talents that employees provide to a business are one example of the actual capabilities that might enhance an organization's financial success [33]. Intangible assets are resources that may be cultivated to assist an organisation attain economic sustainability. Some examples of intangible assets are a company's brand, its expertise, and the connections it has with its stakeholders [13].

RBV's physical and intangible qualities promote team performance. Individual talents determine an organization's capabilities [33]. Business leaders that regard social media as a marketing resource must connect their intangible assets, such as their brand and employees' expertise and talents, to build a distinctive campaign that will enhance consumer engagement and income. The RBV hypothesis helps company executives identify rivals, even franchisees, based on team dynamics [13]. Location influences team members' qualities like customer service and innovation, which rely on resources. Depending on the team members' talents, each organization's tangible and intangible resources are an advantage for the leader's plan. Depending on their resources, business teams' abilities may be a competitive advantage. Assessing team members' abilities and competences and the organization's assets may help executives differentiate their businesses. Valuable, uncommon, and distinctive corporate resources may maximise resource extraction and financial sustainability [5].

These three aspects reinforce the usefulness of RBV as a concept for corporate executives looking to develop strategic financial strategies. Revenue may be generated if a company's highly valued resources are also unique and difficult to imitate [13]. For a longer length of time, a company leader may employ their resources in a more exclusive way [13]. In order for a corporation to stand apart, it may have

special equipment or a unique way of doing business [24]. Incomparable resources are those that are created by corporate leaders employing a collection of people, including their expertise and equipment, to create distinct organisational processes [5]. An advantage for business leaders is the difficulty of replicating or getting the resources of a competitor in order to exceed them [13]. Resources may be pooled by an organisation to produce unique talents for its employees. If an organization's leaders create resources that are valued, scarce, and hard to copy, a competitive advantage could last for a longer period of time [13]. For businesses, discovering their unique resources and people's comprehension of social media as a marketing approach may help them increase income. The conceptual framework of RBV.

Organizational competitiveness may help company leaders use corporate resources, such as team members, in a more effective manner. It is possible for business executives to identify uniqueness in the process and exploit it to build a barrier of entry and to maintain a competitive edge over their rivals [24]. In order for a company's conceptual framework-based plans to be successful, the company's management must identify the abilities necessary to build marketing strategies that concentrate on brand differentiation and financial sustainability [24]. Business executives who can develop a more personal relationship with their social media followers will have a significant competitive advantage [68]. Businesses benefit from identifying resources that may be used to implement strategies for success. Besides RBV, CEOs might employ other theories to enhance their results.

9   Conceptual Framework and Hypothesis

9.1   Social Media and Consumer Purchase

As a result of the rise of social media, businesses and marketers have come up with a slew of innovative concepts that aim to influence consumer behaviour. According to [49], social media has shortened the purchasing process. When making a purchase, a customer goes through various steps. Determine what you need, gather information and consider your alternatives. Then make a purchase. Consumers' sequential processes have been accelerated by social media marketing, according to Permatasari and Kuswadi [49]. As a result, buyers may decide to skip phases in the decision-making process and make their purchase right away. Due to the growth of social media, people now have access to more information. Using this technology, the second phase in a customer's purchasing process, information discovery, might be improved. Product information can be found in plain text, hypertext, magazines, and pamphlets that can be downloaded through social media [10]. Social media today makes it possible to get information from all around the world.

Social media is used by people of all ages; nevertheless, it is often believed that younger people have a greater interest in it. They have integrated various forms of social media into their typical activities. The bulk of time that today's preteens and

early adolescents spend is occupied by their cellphones, which play an important role in their lives [69]. The input individuals get on "social media" has a huge role in shaping both their thinking and the choices they make about their purchases. Because of this, several of the recently opened eateries are completely full [75]. These young individuals have organised groups on social networking sites like Facebook, where they discuss products that they have just bought and exchange evaluations of those products with one another. They also provide a rating to the items so that others may have a more objective view on what they have to offer. Younger users are more engaged than older users on brand websites, and they enjoy commenting and sharing their thoughts.

When it comes to selling products and services, the use of social media removes geographical barriers and eliminates limits. In point of fact, [35] asserts that social media makes it possible for a diverse range of individuals from a variety of walks of life to acquire access to the marketing messages of a firm. This makes gathering product information easier, which in turn encourages customers to make additional purchases [44]. Additionally, [44] argues that when information is freely available, it lowers all types of search costs for consumers, which foretells high levels of behavior associated with purchase intent. This is a result of consumers' being able to more quickly and readily obtain what they require. It is debatable whether the ability of social network platforms to promote two different types of communication between users and businesses constitutes the most fundamental and essentially distinctive feature of social media. One of the key elements influencing consumers' purchasing decisions is this potential [39]. Users are able to exchange material via posts, reviews, ratings, and likes on social media platforms, which are built on the Web 2.0 platform. Although the organisation is the primary recipient of this information's input, other users of the social network are significantly impacted by its presence. As a result, owing to the existence of parallel modes of communication, customers are influenced to make purchases by the reasons given by other consumers on social networking sites. Nikita [45] advanced a similar theory, arguing that there is a correlation between user-generated material and positive customer behaviour. Nikita's argument was that there is a link between user-generated content and favourableconsumer behaviour. The influence of a consumer's social network groupings on their propensity to make purchases is another factor [73]. As a result, social networking platforms enable users to partake in peer and group shopping, which is comparable to when a group of friends shop together in a physical store. Social media's leadership and reference group effects may have an impact on customers' intentions to make a purchase. Customers naturally want to fit in with the group they belong to, so they frequently buy the same products as their fellow customers. In fact, [73] discovered a statistically significant link between group purchases made on social media platforms and consumers' propensity to act in a pro-purchase manner. Therefore, it is proposed that (Fig. 1):

H1: There is a significant positive relationship between FCSMC and CPB
H2: There is a significant positive relationship between UGSCM and CPB
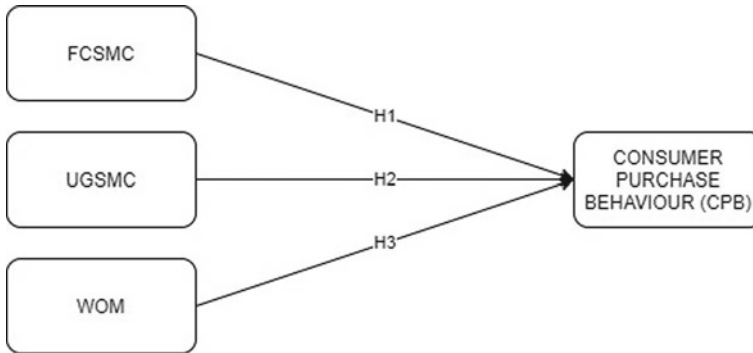*H3: There is a significant positive relationship between WOM and CPB*

Fig. 1 Conceptual framework

10 Research Methodology

10.1 Research Design

According to Saunders et al. [57], this kind of research design assesses whether the independent variable and the dependent variable have a cause-and-effect relationship. The explanation component of the research design was utilized to demonstrate the connections between social media and consumer involvement and how one influences the other. The explanatory design is good because there hasn't been much study on the connection between social media and purchasing behavior [72]. An exploratory study is conducted to assist us in identifying issues that have not previously been thoroughly examined. Explanatory studies do not seek to provide definite solutions, but they do advance our understanding of the issue.

10.2 Population

The target population for the study involved 1400 students of TaTU and its outskirts who are above 18 years.

10.2.1 Sampling Technique/Method

Sampling is described as a selection procedure to evaluate the characteristics of the complete population and draw statistical conclusions from a subset or specific

individuals within the population. The application of research sampling procedures follows the successful collection of the sample frame from a sample size population. Extrapolation is more likely and trustworthy when the sampling technique, which combines sample design and a population quantity estimator, is understood and the target population is identified. Probability and non-probability sampling are the two main categories for selection.

10.2.2 Questionnaire Design

Questionnaire design is a process of multiple stages that requires attention to detail at every level. According to [14], due to its intrinsic advantage, the most prominent research instrument in quantitative studies is the questionnaire. Besides, stressed the importance of ensuring correct and subject-sensitive questions while making a questionnaire is emphasized because the conduct of the respondent depends on certain parameters, which eventually affect their cooperation and performance. The online questionnaire made up of 30 items were distributed. Items have been modified from previous studies to improve the credibility of the research. To suit this current research framework and purpose, the right modifications were made.

Five components make up the questionnaire for this study: In the first portion, the respondents' names, ages, genders, marital statuses, levels of education, and employment statuses were all recorded. The types and uses of social media were discussed in the second section. The final segment examines the veracity of the data from social networks, social media, and peer trust. In the fourth portion, participants were questioned about their internet usage patterns (number of time or hours frequently spent online, use of social networking sites, proficiency with social media, and participation in online debates), as well as how this affected their purchasing decisions. The final section measures the effects of gender on buying behaviour of respondent and frequency of young people buying products online.

11 Data Collection Procedure

The researchers employed an internet-facilitated questionnaire to gather data for the study. Qualified respondents are those who have experience with the Internet. Snowballing (requested forwarding) using convenience sampling to distribute the online questionnaire through WhatsApp as messaging application, Facebook and Twitter as social media channels and e-mails.

The collecting of data is critical to the study's success. To acquire extensive data, you will need a well-documented study procedure and an elaborate approach. Data from a convenience sample of Hong Kong smartphone users with Facebook accounts was used to investigate the hypothesised associations. The survey was self-administered online. The researchers completed the online survey on Qualtrics in about 10 min. The targeted person gave permission and consent for that to be done.

This choice was made in response to COVID 19, which will make it more difficult to collect data from respondents using self-administered hard copy questions. Given that the questions were tailored to investigate the influence of social media on customer purchasing behavior in TaTU, the internet-enabled questionnaire made it simple for the researcher to acquire pertinent data regarding the research issue.

Firm-created social-media brand communication
I am happy with how the company uses social media to talk about Brand X
I am happy with how well the company communicates about Brand X on social media
Brand X's social media messages from the company are very appealing
When compared to the social media of other companies, the company's communications for Brand X do well on social media
User-generated social-media brand communication
I am happy with what other people have said about Brand X on social media sites
I am happy with the level of content that other users of social media sites have made about Brand X
Content that other users have made about Brand X is very interesting
Compared to other brands, the content that other people post on social media sites about Brand X does well
WOM
On social media, it is easy to spread the word about a product or service
When people want to know more about a product or service, they go to the social media accounts of brands
I would like to tell my friends about brands, products, or services I found on brand X's social media
I would like to share social media posts from brand X on my Facebook page or blog
I would like to tell my friends what I think about brands, items, or services I bought from brand X's social media
CPB (Choedon and Leem 2021)
Using this brand's social media helps me make better decisions about whether or not to buy their product
The more I talk to this brand on social media, the more I want to buy their products and services
I will buy this brand's products as they are advertised on social media
I really want to buy something from this company

12 Measures

12.1 Data Analysis

When discussing the data analysis technique, AMOS refers to the dataset for calculating the impacts. Two methods for analyzing the data are path analysis and confirmatory factor analysis (CFA). To assess whether the data is appropriate for further investigation, CFA evaluates the data's convergent validity, reliability, and discriminative validity. A route analysis is then completed to determine the effects. These techniques are included in the structural equation model, or SEM. Ethics is always a crucial element in any field of study, especially research. In order for research to be more authentic and unbiased, researchers must consider ethics when doing it. When doing this study, the researcher has considered ethics a major priority. All participants' consent was obtained before they were included in the data collection procedure. They were also assured that their information would not be used for any purpose other than this study.

12.2 Data Analysis and Presentation

This section's main objective is to analyze and understand the data that was collected in the field. The phase of data analysis and interpretation involves the analysis and interpretation of the collected data in order to produce trustworthy evidence on the design and effectiveness of the intervention. The researcher decided to use structural equation modeling (SEM), which combines testing reliability, convergent validity, discriminant validity, and path analysis, in order to assess any potential relationships between social media marketing and consumer behavior from the perspective of Ghanaian youth. This was done in order to ascertain whether or not there was such an association. The researchers who conducted this study chose AMOS as the experimental medium in order to obtain data useful for evaluating the relationship between the variables.

13 Demographic Characteristics of the Study

The demographic characteristics of the respondents included their age, gender, marital status, and degree of education. In order for the study results to be generalized, it was important that the sample reflect the characteristics of the population. Below is a discussion of the results.

Table 1 Gender distribution of the respondents

	Frequency	Percent
Male	165	55.0
Female	135	45.0
Total	300	100.0

Source Field Survey (2022)

Table 2 Marital distribution of the respondents

	Frequency	Percent
Single/never married	254	84.7
Married	39	13.0
Separated	5	1.7
Divorced	2	0.7
Total	300	100.0

Source Field Survey (2022)

13.1 Gender

Table 1 Indicates the distribution of the gender groups used in the current study. The highest was recorded by Male with 55% whereas the female recorded the least with 45%. It indicates that in the sample, male respondents were greater in number than their female counterparts.

13.2 Marital Status

When evaluating the respondents' marital status, it was found that those who were single recorded the highest percentage (84.7%), followed by married respondents (13%), separated respondents (1.7%), and divorced respondents (0.7%) (Table 2).

13.3 Age

When analyzing the age distribution of the participants, it was discovered that respondents between the ages of 20–29 years recorded the highest with 82.7%, followed by those between the ages of 30–39 years and at the same time those below 21 years. While those above 60 years recorded the least with 0.3% (Table 3).

Table 3 Age distribution of the respondents

	Frequency	Percent
Below 20	21	7.0
20–29	248	82.7
30–39	21	7.0
40–49	6	2.0
50–59	3	1.0
60 and over	1	0.3
Total	300	100.0

Source Field Survey (2022)

13.4 Education

Table 4 presents the educational level of the respondents. It was revealed that respondents with Degree or HND recorded the highest with 79.3%; followed by respondents with Diploma with 18.7%; respondents with master degree recorded 1.0%, respondents with Senior High School Certificates recorded 0.7% while respondents with doctorate recorded the least with 0.3%.

14 Social Media Usage

In assessing the preferred social media, the activity used by the respondents revealed the following. Respondents prefer the use of Facebook, followed by Twitter, Instagram while LinkedIn recorded the least. It demonstrated that people prefer to use Facebook than other social media types (Table 5).

Table 4 Educational level of the respondents

	Frequency	Percent
SHS	2	0.7
Diploma	56	18.7
Degree/HND	238	79.3
Masters	3	1.0
PhD	1	0.3
Total	300	100.0

Source Field Survey (2022)

Table 5 Preferred social media usage

	Frequency	Percent
Facebook	133	44.3
Twitter	99	33.0
Instagram	61	20.3
Pinterest	5	1.7
LinkedIn	2	0.7
Total	300	100.0

Source Field Survey (2022)

15   Social Media Purpose

In assessing the significance, use of the social media revealed that many people use social media for entertainment purposes; followed by social interaction, information search, contacting friends, for attraction purposes while the least was the use of the social media for business purposes. It showed that many people prefer to use social media for entertainment while the least of its usage has been for business purposes (Tables 6, 7 and 8).

15.1   CFA and Reliability

According to Crede and Harms' study, CFA is a widely utilized tool in organizational science, with the primary goal of determining discriminant and convergent validity on a set of variables. CFA is primarily used by the researchers to assess the postulated item construct, and distinctions are represented in the observed data. The indicators' effectiveness and reliability were assessed using a variety of methodologies, including Cronbach's Alpha, Composite Reliability, and Average Variance Extracted (AVE) for convergent validity. According to Hon et al., indications in the factor loading with a value less than 0.6 should be ignored, while values greater

Table 6 Social media purpose

	Frequency	Percent
Entertainment	116	38.7
Social interaction	86	28.7
Information sharing	70	23.3
Make friends	20	6.7
Attraction	6	2.0
Business	2	0.7
Total	300	100.0

Source Field Survey (2022)

Table 7 Loadings and reliability

		Loadings	α	CR	AVE
FCSMC			0.93	0.77	0.57
	FCSMC1	0.77			
	FCSMC2	0.75			
	FCSMC3	0.82			
	FCSMC4	0.70			
UGSMC			0.95	0.92	0.65
	UGSMC1	0.87			
	UGSMC2	0.74			
	UGSMC3	0.78			
	UGSMC4	0.70			
	UGSMC5	0.73			
WOM			0.77	0.80	0.75
	WOM 1	0.88			
	WOM 2	0.77			
	WOM 3	0.74			
	WOM 4	0.87			
	WOM 5	0.73			
CPB			0.83	0.73	0.55
	CPB1	0.74			
	CPB2	0.87			
	CPB3	0.87			
	CPB4	0.75			
	CPB5	0.72			

Source Field Survey (2022)

Table 8 Discriminant validity

	AVE	FCSMC	UGSMC	WOM	CPB
FCSMC	0.57	**0.75**			
UGSMC	0.65	0.62	**0.81**		
WOM	0.75	0.71	0.70	**0.87**	
CPB	0.55	0.67	0.53	0.66	**0.74**

Source Field Survey (2022)

than 0.6 are considered acceptable; however, 0.6 is the desired minimum value in the factor loading. Because all of the loadings above the 0.6 criteria, all of the constructs-measuring items were accepted.

By assessing the internal consistency of the responses, Cronbach's Alpha will be utilized in the future to assess the dependability of the variables [64]. To be regarded as reliable and internally consistent, the indicators must have a Cronbach's Alpha value of better than 0.6. A Cronbach's alpha value of less than 0.4, according to Baheiraei et al., denotes weak dependability and suggests that the variable is problematic. According to the Table 1 results, all of the study's variables had Cronbach Alpha values more than 0.6, indicating that the variables are internally consistent and hence the data are reliable. According to Boduszek et al., composite reliability is a more relevant and effective method for determining scale reliability than Cronbach's Alpha. Martinez considers 0.6 to be the composite reliability level. According to the survey's constructs, the composite reliability value was greater than 0.6, indicating that the reliability is of composite material. Finally, the average variance extracted (AVE) was examined, which has a threshold of 0.5 according to Huan et al., but a value of 0.4 can also be considered acceptable if the composite reliability of that particular construct is greater than 0.6. Every variable had an AVE greater than 0.5, with the exception of brand equity, which has an AVE of 0.419. Although Brand equity has a composite reliability of 0.760, the threshold for the variable is 0.4, implying that it can be kept.

15.2 Hypothesis Analysis

See Fig. 2.

Hypothesis analysis
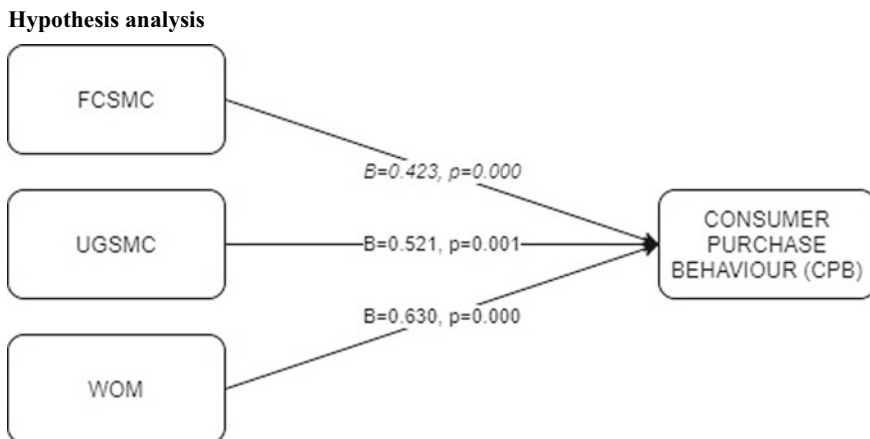
Fig. 2 Hypothesis model. *Source* Field Survey (2022)

Table 9 Hypothesis testing

Paths	Hypothesis	t-value	β	p-values	Decision
FCSMC → CPB	*H1*	12.53	0.423	0.000	**Accepted**
UGSMC → CPB	*H2*	9.56	0.521	0.001	**Accepted**
WOM → CPB	*H3*	14.70	0.630	0.000	**Accepted**

Source Field Survey (2022)

15.3 FCSMC on CPB

Table 9 shows that the beta value of firm-produced social media communication was 0.432, the *T*-value was 12.53, and the *p*-value was 0.00. This demonstrates that corporate social media communications have a large, unfavorable impact on consumers' intentions to purchase mobile phones. The correlation between corporate social media communication and customer purchase intent was 0.67 during the same period. The findings of this experiment are displayed in Table 8. The connection had a *p*-value of 0.00, which was statistically significant.

Although there is a substantial adverse relationship between business social media engagement and client purchase intent, the study rejects the null hypothesis since there is statistical support for the idea that business social media communication negatively affects consumers' intentions to make purchases (H1). Therefore, as mobile phone businesses post more content on social media, people are less inclined to purchase the products. In other words, consumers are less likely to make a purchase when businesses use social media more frequently. Consumers' propensity to purchase is negatively impacted by messages from mobile phone providers by 74%. Earlier empirical research has produced similar findings. For instance, [35] asserts that company-generated information is self-reflective, which diminishes its credibility when attempting to balance the views between actual product performance and marketing philosophies. According to Schivinski and Dabrowski, company-produced communication had a negative effect on consumer behavior. Other investigations also came to the same conclusion [2, 34, 49].

16 UGSMC on CPB

User-generated social media communication had a beta value of 0.521, a *T*-value of 9.56, and a *P*-value of zero, as shown in Table 9. (see Table 9) These findings imply that user-generated social media communication influences customer purchase intention in a favorable way. The association between user-generated social media communication and purchase intent, on the other hand, was found to be 0.53. (Table 4). This demonstrates that there is a slight but positive correlation between the two variables. The 0.00 *p*-value indicates that this association is statistically significant. We reject the null hypothesis because there is statistical evidence that user-generated

social media communication influences consumer purchase intention in a positive way (H2). According to a recent study, a business's revenue rises directly as a function of how many individuals sign up for its social networking platforms. Contrarily, user-generated material had less of an impact on consumers' intent to make purchases. Customers have been shown to be strong, logical humans who trust what other people say about a certain good or service. According to [35], there is a considerable positive association between customer purchase intents and user-generated social media communication. According to the report, businesses should never undervalue the importance of what their customers have to say. If brands don't exercise control over the creation of user content, it has been demonstrated that their reputations could be harmed by user-to-user and viral social media messages.

17   WOM on CPB

The study showed that customer purchase intention is significantly influenced by word-of-mouth propagation through social media ($= 0.630$, $t = 14.70$, $P = 0.000$) using SPSS regression output Tables 3 and 4. The correlation between social media word-of-mouth and the willingness to make a purchase was 0.66, which is somewhat favorable. We conclude that the null hypothesis is false and that there is statistically significant evidence to support the assumption that word of mouth on social media influences customers' propensity to make a purchase.

The conclusion drawn and the interpretation of the results both highlight the potency of viral marketing in influencing consumers to make purchases. In fact, word of mouth on social media had the highest positive strength and influence on purchase intention when compared to all of the other social media elements that were examined for this research. This suggests that in order to activate their desires and, as a result, initiate the decision-making process, consumers fundamentally believe that viral messages are authentic and informative. Even earlier empirical findings concur with the views found in this analysis, as did the specific study's conclusions. The results of many studies that looked into the role of word of mouth suggest that it can either help or hurt a company's brand. According to Schivinski and Dbrowski [58], Hoyer and MacInnis [26], and Nikita [45], it has been demonstrated that when brands are supported by positive word-of-mouth, buyers are more likely to make purchases. The opposite is also true, though. Kulimula [35] suggests that enterprises in this situation listen in on the discussions their clients are having.

18   Conclusion of the Study

Social media has a significant impact on young people in the Tamale Metropolis and throughout the world. The number of social media pages, the types of social media, and their users are all on the rise. Currently, most apps have a social component;

normal apps with a different primary intent may serve as a social media network by linking users to each other. Social media plays an expected role in customers' lives in such circumstances. Unquestionably, social media is both critical and useful to organizations and young customers as well.

As shown by this research, for the younger generation, social media may have many influences. Social media has countless benefits for customers; all of them boil down to one thing: which is data. To make fast and accurate buying decisions, customers need information and this information has been made assessable with just a click on Social media. Customer feedback can be easily done on social media which enables their opinion to be assessable to marketers that they normally buy products from. In Tamale, the youth of today operates so much in the digital world than in the real world, and this has become a type of obsession. This forum also fits those seeking recognition. Companies in Tamale and Ghana have dramatically increased their budget on social media marketing, although its efficacy requires more study.

Therefore, it can be said that social media has indeed influenced young people's consumer behavior in Tamale Metropolis in such a way that people's quest for information tends to drive them to use social media and their trust in their peers tends to influence their usage of social media. The relationship between respondents' internet use and their amount of information sharing was assessed, and the results showed that there was a strong correlation between them. This indicates that internet use has a higher impact on information sharing than previously thought.

19 Suggestion for Further Studies

The limitations of surveys make the results susceptible. The replies on which this research is based were only provided by participants who gave their consent to participate in online media, and the response concentration is substantially higher for males than for girls. The demographic makeup of social media users is the sole focus of this study. This research was focused on Tamale and cannot be considered indicative of the whole of Ghana. The degree to which social media marketing is being used by local communities might be fascinating. It is also important to study that while customers like to obtain information via social media about goods, what kind of relationship exists between them? And how long are they committed to the brand. Therefore more characteristics of the consumers and how these variables impact the purchasing decisions can be useful to research.

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The Contribution of the Internet of Things to Enhance the Brands of Small and Medium-Sized Enterprises in Iraq

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Abstract   Recent times have seen the Internet of Things (IoT) becoming one of the strategic resources of small and medium-sized enterprises (SMEs). The study's main objective is to explore how the implementation of the IoT will affect the branding of Iraqi SMEs. In-depth research should be done on how clients view the brand, its value, and the reputation of SMEs that employ IoT in their operations. Iraqi SME brands must overcome barriers and difficulties to grow on international markets. The fundamental problem is that there isn't enough information available when it's needed to understand the market condition and make wise judgments. Because end users need more information, decision-making processes are hampered, which makes it challenging to satisfy key market demands. To explore the features of utilising the IoT on the brand, the researcher used a qualitative method that included case studies and semi-structured interviews in three cases of SMEs in Iraq. The findings illustrate that SMEs' performance in their activities and services can be improved by increasing flexibility in managing activities via speed of reaction and ease of management. The outcomes also demonstrated the IoT's assistance in meeting the demands of end-users in SMEs by delivering timely information and reports. The IoT contributed to enhancing customers' loyalty by meeting their needs and responding quickly to their requests. These benefits were achieved through the handling of massive amounts of data acquired from internal and external sources and categorised and processed in real-time. This study will be of interest to other experts in this subject, particularly those from Iraq and the Middle East.

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1 Introduction

Everything around us has gotten smarter, resulting in the advancement of several fields of knowledge, especially in industries such as home automation, industrial automation, and telecommunications. IoT is a communication environment that enables gadgets and objects to communicate with one another across a smart network for information sharing and communication between humans and physical items [1]. The researcher describes the IoT as a network system for tying together gadgets and physical objects and managing them through sensors in a number of businesses as a result. The embedded sensors allow information to be exchanged, processed, and presented to end-users and machines for them to make decisions in the shortest amount of time, at the lowest cost, and with the least amount of human work. The significance of sensors in the IoT for businesses is dependent on the architecture of the IoT. According to the IoT's architecture, any device connected under the IoT's umbrella includes internal sensors, emphasizing the sensors' role in receiving and sending data and instructions, as well as gathering generated data from various sources, while this data is less helpful if adopted separately. As a result, the IoT collects, indexes, and analyses data while also continually updating it so that it is ready for end-users. A study by the US Company Kenco found that 56% of people interested in the supply chain want to use sensors connected to the IoT to improve operational efficiency, up from 42% in 2017.

This study intends to accomplish this by examining the benefits and difficulties of the IoT implementation in Iraqi SMEs to strengthen the brand. The following looks to be the contribution of the IoT, according to Brous et al. and Rathore et al. the supply of technical services to maintain and improve infrastructure, process automation, cost-saving measures for both physical resources and labour, timely information delivery, the development of more precise data analytics, and bolstering the ongoing follow-up and implementation processes. [2, 3]. Businesses can use the IoT to link their devices. This functionality allows enterprises to measure and monitor important performance indicators such as overall equipment and process efficacy in real time. By tracking these measures [4, 5], companies may be able to discover and solve the reasons for unexpected halts, do routine maintenance, and use the equipment for extended periods [5, 6]. Developing a brand for an SME requires a lot of market data and knowledge, as well as information about the internal and external environment. This information needs to be sent to the beneficiaries in real-time, which is a difficult, expensive, and time-consuming procedure [7], while IoT capabilities aid in improved administration and control of these operations. This can be done by giving decision-makers the right information and reports at the right time, in the right amount, and in the right format [2, 3].

2 Research Background

2.1 IoT in SMEs

The literature review shows the role of IoT in controlling and communicating with millions of devices, which helps companies make money and be more productive [8–10]. Prior studies have not addressed the study settings via the aspects of IoT that might enhance SMEs' branding, particularly in Iraq, and the constraints that SMEs have been using IoT technology. According to the report, the IoT has a direct influence on increasing strategic decision-making and brand value for Iraqi SMEs [11, 12]. The study's problem revolves around the following key question: What impact does the use of the IoT properties have on SMEs' branding in Iraq? We seek to accomplish the following research goals: The advantages of deploying IoT in commercial enterprises are discussed, as well as their significance in SME branding in Iraq. The qualitative method of gathering and analysing data was used to figure out what was stopping IoT from being used. An explanation of how the IoT helps Iraqi SMEs improve their branding. These goals will be met through gathering data and critically analysing it to determine the strengths and weaknesses of applying the study contexts, achieving the study's goal, and solving its challenges.

2.2 The Iraqi SMEs' Determinants

Previous studies have shown that SMEs may experience difficulties in the external environment in some governorates of Iraq, notably in the business sector. Specifically, operational issues, monetary issues, infrastructure issues, and marketing and advertising issues [11–13], whereas our work helps to address monetary issues by reducing production and data collection expenses using IoT. By identifying customer demands, granting their requests, and providing knowledge about new markets, the Internet of Things (IoT) contributes to marketing problem solving in addition to creating technological infrastructure for private-sector firms.

2.3 The Description of the Sample

Case A is one of Iraq's distinguished firms, having grown from a small firm with limited capacities to a medium-sized business. Company A was established in 1973 in Baghdad, Iraq, under Iraqi regulations and with very little resources. This firm is distinguished in the electronic device industry because its products were limited to television radios and traditional telephone devices in 1983. Then, in 1999, company A products were developed to make computers and power equipment like DC to AC converters, battery chargers, and control devices for solar systems. The firm was

notable for its achievements in the development of numerous telephone gadgets that met international standards. After 2005, the manufacture of PABXs, high-quality 3D flat-panel TVs, and smart interactive TVs marked a watershed moment in the firm's history. Its products are distinguished by their precision and efficiency of performance, as they are supported by cutting-edge technologies that keep up with current scientific advances. Case A was eager to stay up with global technology since it excelled at using the IoT through its activities to develop products and gather data on local market needs. Where sensors have been included for the maintenance of smart TVs, which aid in the diagnosis and processing of issues, it also displayed the interactive whiteboard, the first product of the most recent smart technologies with excellent specifications and quality. Customers liked and followed the firm, and it received 21 thousand likes and follows.

Case B is one of the most prominent medium-sized firms linked with the Ministry of Communications. Company B is distinguished by the fact that the majority of its engineering and technical personnel have doctorate and master's degrees and have amassed expertise in a variety of sectors. The ability and experience of this company in supplying, designing, and maintaining the most advanced and integrated systems in telecommunications, wireless, electronic monitoring systems, communications and information security systems, software, internet technologies, alarm systems, and tracking systems sets it apart. Because all of these systems rely on IoT sensors to send and receive data and operate them. The firm was picked because it aspires to develop its information technology service operations and performance by contributing to the advancement of the field of communications. Because the company has people who know a lot about communications and digital signal processing, it has experts who can make systems and provide different kinds of services that meet the needs of the people who use them.

Case C, the firm, is one of the important small businesses, among many others. Founded in 2005 in Baghdad, Iraq, it started its activities with very limited capabilities and a small staff. Company C has gone through many trials and challenges and is striving for development, fame, and a distinctive brand. Today, it has become one of the important companies in providing its technology services to customers in a variety of fields, most notably e-government systems, access control systems, security systems for oil fields and urban areas, network solutions, and software solutions. IT and IoT technologies are used by the company to design systems and manage its relationships with its customers. This company was chosen as a case because it is owned by the private sector, as it is owned and operated by one family, where the management team consists of the father and his three sons, and the engineering team. The firm started as a dream and then became a reality through its establishment. The small firm brand has become known for its quality and persistence in thinking to come up with innovative solutions that meet the needs of its customers. Company C is today one of Iraq's pioneers in the fields of networks, security, automation, and software. The company team understands that there is no one-size-fits-all solution because technology solutions or system design must support each project according to individual customer requirements and needs. In addition, the company has more

than 1800 fans of its services, in addition to 1880 followers, despite being a small company.

3   Research Method

In terms of philosophical presuppositions, interpretivism is the associated epistemological presupposition of this qualitative study [14, 15]. By conducting semi-structured interviews with participants to discover why by analysing the issue and interpreting the truth, the researcher hopes to interpret the reality of companies' "sample of the study" [16]. In order to answer the study topic, qualitative approaches are employed to uncover the various realities of "events and actions," and social reality must be uncovered inside. [17, 18]. The truth is interpreted based on what the researcher sees during the interviews and then displays the findings and confirms them. In order to recognise and analyse its impact on the research question, interactionism and the phenomenology hermeneutics method are chosen in the theoretical perspective [19]. To create a more comprehensive and realistic theory for the project, an inductive technique is used, which will advance the literature. According to the literature, a range of methodologies, including case studies, narratives, and action research, might be associated to qualitative research. This study will employ the case study methodology [20, 21]. Based on the study questions, the data to be gathered, and the research sample, this choice was made. Case studies help describe and evaluate various facets of the topic being studied. The target sample of participants includes managers, heads of departments, and officials from the information technology departments of SMEs. The researcher wants to investigate the participants' characteristics and the nature of their interaction in terms of using IoT in SME activities and obtaining the requisite interactive sensory data [15, 21, 22]. As a result, the researcher collected both confirmed and non-probability samples from the participants as well as split the data (written or spoken) into categories that would aid in the analysis and interpretation of the findings. The methods of the study focused on how data is collected using a qualitative approach and how it is analysed using thematic analysis [18, 21, 23, 24].

SMEs that use IoT technology in their operations and services were included in this study. The following are three cases of these firms that will be discussed in this paper: (case A, case B, and case C). This is owing to the relevance of SMEs in the study's subject, particularly those businesses that use information technology and IoT to support their operations and strive to increase their performance and brand value. These three cases were chosen as a sample to define and explore concepts by studying the end users' SMEs' views of the issue under investigation because the owners of these businesses want to improve their operations to increase profitability and performance. In addition to the enormous growth in the number of followers and admirers, their usage of IoT technology is noticeable. This might help to achieve the study's goals.

Data is gathered through semi-structured interviews and spontaneous discourse from the selected cases. More than five semi-structured interviews were conducted for each case. The manager of each department was contacted by the researcher. Semi-structured in-depth interviews were conducted by the researcher using online meeting software. These interviews were conducted in Arabic, and the information was then converted to English. To thoroughly and in-depth understand the data, thematic analysis approach was used. Codes and themes are recognised in accordance with the data analysis. The fundamental data tenet upon which concepts are recognised is the identification of coding, where concepts are comparable symbols sorted into groups [21–25]. Data analysis was aided by the use of Nvivo software [24–26].

4 Discussion of Findings and Conclusions

4.1 The Findings

Data was collected from all case studies to explore the phenomenon and answer the study question. The results of the analysis show that many elements and codes have been put into themes (such as improving performance, increasing the value and awareness of branding in the market, and increasing the rationality of decision-makers). These themes may significantly impact the increase in brand value, as shown in Fig. 1.

In comparison to large corporations, SMEs have particular difficulties because of a lack of easy access to information [27]. In contrast to major corporations, SMEs must have enough money to pay for the cost of obtaining sensitive and correct information. In-depth market, product, and service research is also required, and this takes time and money. Because of these expenditures, SMEs may not be able to effectively predict the needs of the future market, resulting in a lack of a competitive edge or a worldwide brand. Iraqi small businesses can afford the technology used by the world's most well-known e-companies [28, 29]. SME's performance in their activities and services was improved by increasing flexibility in managing activities via speed of reaction and ease of management. For example, Company A offers a smart TV with IoT sensors that aid in the diagnosis of issues, allowing engineers to respond promptly and collect updates on the device's state. Furthermore, in cases B and C, the IoT is also used to help control and fix systems if they break down, which is designed to meet consumer needs.

The findings also demonstrated the IoT's assistance in attaining flexibility and speed in meeting the demands of end-users by delivering timely information and reports. Increasing the speed with which performance activities were completed contributed to increasing client loyalty by providing their needs and reacting quickly to their requests. The IoT contribution involves addressing both real-time and big data problems, as many IoT applications have unique characteristics for analysing
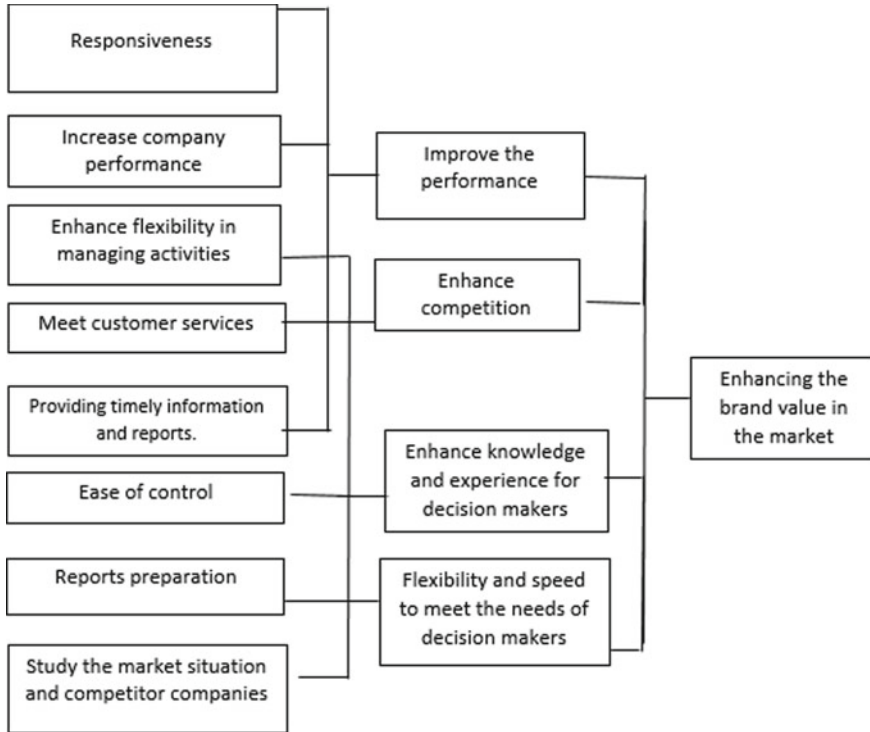
Fig. 1 The implementation of the IoT in Iraqi SMEs

the rapid flow of big data in real-time, including smart grid applications and data flow processing systems. The researcher came to the conclusion that the processing of enormous amounts of data obtained from internal and external sources and classified and processed in real-time is one of the most significant contributions of IoT technology to SMEs. According to Beekman (2021), the use of IoT technology by SMEs boosts productivity and helps to reduce expenses. Additionally, it is possible to enter brand-new markets that were previously tough to select to enter. But for IoT applications to be useful in strengthening brands and adding value to goods and services, they need effective management and security solutions [6–8].

Relying on regular IoT reports may help save money on performance and data collection. By swiftly delivering and processing information that is important to decision-makers, the IoT helps with a quick study of the market environment and competition among SMEs. Customer input on the services of the three organisations is analysed and indexed to aid strategic information systems. The following are the most notable features of SMEs: The owner of a small business is in charge of both the administrative and technical aspects of the business. Small businesses require less capital than large corporations, and they can rely on primary local resources to cut production costs and boost profits. They also have greater adaptability and

a greater capacity for expansion because of their ability to respond to changing conditions. Finally, SMEs could use IoT services to get feedback that will help them grow and develop their products and services to increase customer happiness and brand value.

4.2 Conclusion

The study showed that the application of the IoT has many actual contributions to supporting SMEs, especially improving their reputation among competing companies in markets. The study included qualitative interviews and a case study method of three Iraqi SMEs. Despite the specific implementation of the IoT in certain services and not in all the firm's activities, its contribution was obvious, according to the explanation of the participants in the interviews. The most important benefits of using the IoT are that it helps improve flexibility, performance, operations management, speed of response to market demands, and meet customer needs in real-time. The experience of the employees and the lack of customer knowledge of IoT services are among the determinants that must be addressed by the studied firms. The findings also showed that the adoption of the IoT is possible in the Iraqi context and for Iraqi SMEs in particular.

4.3 Recommendations

SMEs need to work with e-companies that know how to use the IoT to control their activities and share information [27]. One feature of the IoT is the use of e-commerce platforms, which help SME brands become well known around the world [30]. The Iraqi government needs to make policies and rules to help SMEs adopt new technology [31]. The IoT implementation is important for the success of Iraqi SMEs because it gives them "automated information and reports; electronic control of things; managing information systems; maintaining devices; talking between devices; human-device interaction; and data transfer" [12].

4.4 Future Scope

IoT technologies are a broad field that is not limited to a single industry, as it is possible to provide essential services in a variety of industries. The research was limited to SMEs in the manufacturing and information technology industries. As a result, this study can be applied to a larger scale of SMEs as well as large industrial companies. Also important for the future work of IoT researchers and scholars is

how the study could be used in other areas. Future research might focus on the communication, health, or education sectors.

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Trust Chain for Managing Trust in Blockchain-Associated IoT-Enabled Supply-Chains

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Abstract Recognizability, as well as trust worthiness, remain important encounters aimed at today's incomprehensibly complex supply chains. Despite the fact that BC expertise may remain able in solving these issues via availing a well-constructed audit track of accumulation system events besides statistics relevant to an element's lifespan, the problematic confidence is not indicated in the actual information. Notoriety frameworks are a persuasive solution to address this problem of trust. Current frameworks, on the other hand, are unsuitable for blockchain-founded production system requests since these rely upon proceeding limited observations, need granularity and computerization, and their above has not been studied. In this paper, we present Trust-Chain, a tri-coated trust in the executive's structure that routines an association BC in the tracking of production network member communications and gradually downgrade trust and notoriety ratings in light of such associations. The uniqueness of Trust-Chain stems from the vertical prototype, which evaluates the property of substances besides the trustworthiness of substances in light of various observations of accumulation system events, the situation support aimed at dishonor notches, which differ among an invention system associate besides substances, enabling the mission of article unambiguous dishonors for an analogous associate, as well as the use of clever promises aimed at simple, proficient, safe, besides automatic estimation of items.

Keywords Blockchain · IoT · SupplyChain · Trust

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1 Introduction

BC has a time staggered collection referring to irreversible information documents that may strengthen traditional stockpile chains by adding recognizability, provenance, ownership data, and anticounterfeiting. Events like dealings, possession, along with where abouts information have been hashed as well as connected with BlockChain exchanges in BC-based supply chains. Those dealing shave been organized within sections as well as connected through CG-hashes, forming those unchangeable [1]. The importance of spontaneous affirmation for store network actions is completely understood within the foodstuff supplychains, wherever it has been necessary for tracking item origins otherwise recognize misrepresentation sources, likely to be as mall meeting embarrassment, else flare-ups' origin, for example, a salmonella's infection in papaya. A collaborative permitted BC may make all siloed production network event information available to all permitted members, increasing recognizability and saving time. Regardless, the reliability of information is seen as an incomprehensible concern to BlockChain-dependent supply-chains. Here considering the article, employing food stuff is likely to be the delegate production network utilization model but note so as a presented arrangement might summarize for various stockpiling series. Figure 1 depicts a food item's inventory network, starting with the primary manufacturer and ending with the retailer [2].

The majority of conventional BCs rely on the generation and distribution of computerized resources. BC provides unchangeable nature as well as verification that the stored information is correct and trustworthy in these applications. In light of public-key cryptography and computerized markings, this component is the result of reconciling the generation and movement of computed values with dispersed agreement instruments [3]. For example, in Bitcoin BC, the Proof of Work (POW) agreement component coordinates the generation and movement of bitcoins. However, the hashed data upon BlockChain locations computerized observation with regards to
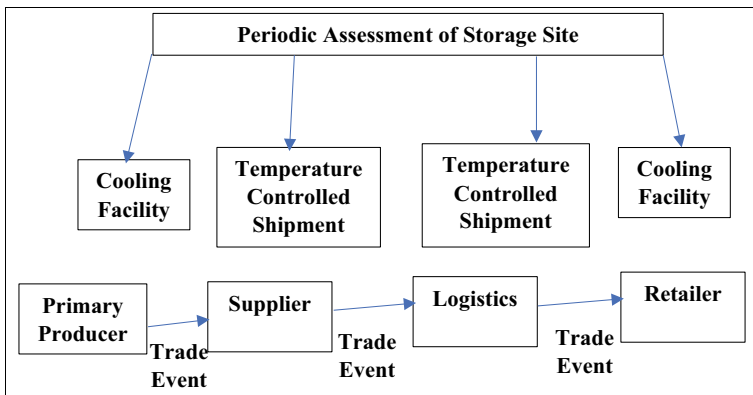
Fig. 1 Makers, suppliers, coordinated operations, merchants, and controllers are all part of a typical food production network

genuine events for real product and resource trading applications. Even though data associated with production network events are unalterable if already taped upon the BlockChain, a BlockChainis unable to assess the veracity of perceptions provided by production network substances. The information's legitimacy and trustworthiness become an issue, raising concerns about the BC's information respectability [4].

We argue in this study that, although BC is a successful invention for managing production network recognizability, it cannot ensure the confidence and dependability of information about the nature of commodities and the reliability of production network substances on its own. Once recorded on the BC, misleading information generated by production network chemicals becomes unchangeable. One technique to cope with work on information trust and consistency has been used as responsibility along with remuneration instruments for penalizing, furthermore, reward untrustworthy as well as reliable individuals separately. Those components depend upon the distributed belief in the board architecture (often used in the web-based company) that we propose to coordinate inside a production network BC [5]. This approach might as well make the most out of information produced through Internet-of-Things detectors (such as atmospheric conditions and area), that have typically gradually implanted at various stages of the production network lifespan (for example ranches, fabricating plants, steel trailers). IoT sensors, on the other hand, are vulnerable to flaws else male volent invasions, moreover, hence this can't rely on impetuously. Besides Internet-of-Things detectors, here different impressions contribute toward trust within reality, for example, food stuff administration endorsements, a merchant's brand image in a food market, and so on. Furthermore, present techniques measuring executive trust whichever characteristic a standing concerning substances (for example, specialist-dependent) otherwise resources (i.e., skill-based). However, a production network substance (for example, a supplier) may be involved in the exchange of many goods at the same time, in which case the reputation for each kind of item becomes critical. Inventory network applications need increased flexibility and granularity since we must trust not only the substances and commodities but also the elements inside a single item production network. Finally, within the BC-based production network structure, the reconciliation of the trust in the executive's framework should familiarise negligible overheads with inactivity, throughput, and asset utilization [6]. In summary, the following are some of the challenges in developing a successful standing framework in supply chains:

(1) The need for a multi-layered evaluation of the reliability and quality of the information signing on a BlockChain, that has consolidated record by Internet-of-Thing detectors, criticism from production network entities, actual reviews, and so on.

(2) A production network member may exchange multiple types of wares; a member needs to evaluate unmistakably concerning to every one of those kinds, moreover, thus ought to a singular item dependent upon even if their superiority had been conserved throughout an item chains;

(3) For carrying out all punishments along with motivations, a mechanized structure
    is required that provides recognizability of production network events and links
    each of these events to a member's trustworthiness [7].

To solve the aforementioned issues, we offer Trust Chain, the three-level Block
Chain-dependent faith the CEOs structure that represents a resulting innovative
commitment:

a. A Block Chain-dependent standing along with a faith structure concerning
   supply-chains which therefore functions upon each the specialist along with
   asset-level furthermore estimates an information accuracy in light of various
   data sources. The structure allows for flexibility in registering the status at many
   levels of contemplation, from the item to a specific store network substance, and,
   shockingly, the role of this element in a specific item's production network.
b. We influence dazzling agreements for computerization related to attribute compu-
   tation through BlockChain exchanges as well as retributions for activating privi-
   leges along with responsibility concerning each of the inventory network contrib-
   utors also the kind of food item making swapped. Production network members
   and products get notoriety ratings as a piece of their dependability for an exchange
   occasion as a consequence of the brilliant arrangements. Members of the produc-
   tion network are then either penalized or rewarded for their collaboration in the
   network by receiving high ratings [8].
c. We encourage the use of Hyperledger Fabric to implement Trust-Chain in its
   entirety. In contrast to an exchanging model that does not integrate a trust
   in the executive's framework on BC, here assessments disclose wherever all
   components offered through the structure bring minor valuation with regards to
   output as well as idleness. We also conduct a subjective security examination of
   Trust-Chain's resistance to known attacks on reputation systems [9].

The following is how the remaining study has been planned: with Sect. 2 focusing
on the Trust-Chain's structure. Section 3 introduces the security evaluation and
execution assessment process, which concludes in Sect. 4.

2 Notoriety and Trust in Supply Chains Based in BC

Recognizability and trustworthiness are key challenges faced by production network
management frameworks, as discussed in Sect. 1. Here have been two fundamental
needs considered to provide recognizability as well as reliability within supply-
chains: (1) the details considered for providing discernibility along with respectability
about a mass system events, article specifics indicating their characteristics, Internet-
of-Thing detectors details, furthermore, another strengthening wellspring of data
(such as BC protected) in addition to executive sustenance must keep within the
carefully designed method, and (2) the dossier must legitimate. The BC invention
satisfies the primary need by disseminating a well-designed record. The goal of our

effort is to satisfy the next need by developing components that establish confidence in information from the start and ensure the data stored at BlockChain has been trustworthy [10]. Because supply chains consist of a variety of substances and item kinds, Trust must be built upon the rough stage, considering the many different kinds of things, constituents, along with their exchanges. Moreover, an interface might digitize, allowing for live recognition [11]. For accomplishing it, here a suggested structure, Trust-Chain, includes the BlockChain incorporated organization as well as notoriety component which assesses production network information accuracy and calculates granular standing ratings for goods and production network substances. We use brilliant agreements, which are self-executing programming programs that are invoked when specific circumstances are satisfied, to computerize the engagement [12].

As shown in Fig. 2, the TrustChain structure is divided into three-layer: data, BlockChain, along with utilization by sustainable elements [13]. The information layer includes production network information given by sensor devices, substance exchange events, and administrative support [14]. The unprocessed information can be processed inside a data set on its network-layer (off-the-chain), and the information text condensation has been transferred as BlockChain-layer exchanges. Exchanges have been saved at record upon a BlockChain layer as well as progressed congruent with a group of admittance criteria defined by the Access Control List (ACL). Whose been permitted either study and put in writing on a record is determined by the entry rules?

The transactions result in spectacular agreements, that produce notoriety as well as trust-values considering substances along with superiority assessments to items with standing as well as trust-module. Brilliant agreements as well send out forewarning actions based upon established parameters (for example, whenever a refrigerated item has been put away over zero degrees). On a BC, the status along with trust-values of production network substances and products are stored in computerized profiles
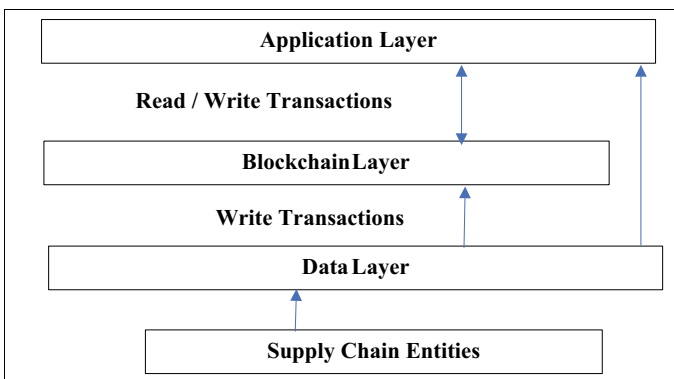
Fig. 2 The TrustChain framework is built in three layers

[15]. Finally, via inquiries, the applied surface communicates through BlockChain-layer. Executives and controllers inquire as regards the trustworthiness as well as the standard of specific substances along with things. When an item-chain has been completed, the nature of the ware is also made available to the buyer [16]. They conduct rewards and punishments based on the recovered scores, rewarding high-scoring compounds by disseminating their scores, punishing low-scoring components by expulsion from the organization, and disseminating item evaluations for conclusive buyers [17].

We use TrustChain as a support stage on a BC when a trading system manages the authorized BlockChain system, an executive who sits among a production network components, along with the BlockChain organization. A trading system executive is in charge of the BC and is responsible for defining the business network model [18]. Because it supported commercial use, as well as simple to send, along with the accessibility with regards to apparatuses to BlockChain organization, executives, information doubt, brilliant agreement execution, along with across authoritative coordinated effort, we chose Hyperledger Fabric for the arrangement [19]. Note that, rather than using a BC as a support stage, TrustChain may instead be performed upon the Hyperledger-Fabric-dependent different organization BC system inherent in the association concerning production network organizations [20].

To be distinguishable in the corporate organization, we require the substances to retain a static public key. When a substance provides a question/compose exchange, the approving companions ensure that the interaction follows the ACL rules (see Fig. 3).

Supply chain participant's Transactions and Update Rules	Ledger Readability Rules
SC participants are not allowed to update their digital profile	SC participants can view a history of their transactions only
SC participants can add commodities under their ownership	An auditor can view the transaction history of all participants
Restrict TXcr to the primary producer, Restrict TXtr to SC traders	Regulators can issue a specific query on TX history
Restrict TXtemp to sensor device only	Restrict commodity reputation
Supply chain participant's Penalties and Rewards	
Regulators can publish ratings among SC participants	
Regulators can revoke, or allow SC participants based on the trust level	
SC participants can report others to the business network admin	
Sort SC participants based on Trust values	

Fig. 3 The criteria for accessing the Trust-Chain's assets are characterized by upper leg tendon

3   Evaluation and Outcomes

The TrustChain structure is subjected to the personal safety as well as defense assessment, a proof of concept implementation, along with the measurable presentation evaluation in this segment [21].

3.1   Analysis of Security and Privacy

In this section, we discuss well-known threats against standing frameworks, and Trust-Chain must be capable of defending from those. Controllers, business-network executives, along with Hyperledger aristocrats have been believed genuine as well as are exempt from the Trust-Chain's risk prototype [22]. Hyperledger underwriting aristocrats have been banned to use the hazard prototype because every deal that is vindictively endorsed through a sole acquaintance, eventually, is verified through every authorizing friend ahead of this has been recorded. As a result of BC's underwriting procedures and agreement components, the malevolent companion is very unlikely to become effective [23]. Review how TrustChain plans to address the production network trust problem, which is connected to the nature of objects and substances recording data on the blockchain [24]. As a result, in our aggressive statement model, enemies include manufacturing system things that could alone else be collaborating with other manufacturing system things, falsifying a data origin after fiddling with detector settings, creating misleading things, registering through different identification cards, making false evaluations with regards to other manufacturing system substances, impersonating another personality, and failing to recognize exchange events; all to deceive the information source [25]. Table 1 summarises these attacks and explains the many components integrated into Trust-Chain for protecting through it [26]. Consider this in Table 1, here just contemplate threats on notoriety frameworks as well as do not allow system assaults generally. We also break down the likelihood of these attacks occurring and Trust-Chain's adaptability against them in light of the European Telecommunications Standards Institute (ETSI) risk evaluation measures [27].

TrustChain has great flexibility against eight of the nine attacks considered in Table 1, and moderate adaptability against the remaining assault. In light of the anticipated confirmation to appraise the quality, we briefly discuss the topic of unjustified assessments, It may result in the trader issuing a "disappointment-banner" to an untrustworthy customer [28]. A validator sends the banner message to the Rep_{seller}, who recalculates it. However, if the shop purposely displays a disappointing banner for the legal customer, this might result in an endless loop. The authenticator could resolve it after reducing the weight by considering the procurer's appraisal-w_2 as well as reconsidering the Rep_{seller} proviso:

(i)   other merchants are upraised disappointment-banners concerning the same buyer, furthermore,

(ii) the number of back-to-back disappointment-banners taken up through a vendor to a buyer isn't equal to the quantity of swaps among them. Those factors show as of a merchant's dissatisfaction banners have been genuine [29].

3.2 Confirmation of the Concept's Execution

Hyperledger Composer, an advanced device for developing as well as executing uses above all the Hyperledger-Fabric stage, was used to generate a proof of concept execution considers Trust-Chain [30]. Following the conditional language shown in Sect. 3, we exhibited the trading system at Hyperledger-Composer about product switching between three production system substances: vital producer, delivery service, as well as vendor. We used REST APIs to send exchanges and questions to the delivered blockchain business organization. The TrustChain execution is represented by the following phases from start to finish:

A. A worthy contract has been formed to merchandise through thermal situations that are properly specified for the kind of item.
B. Substances in the production network register with the organization and have been allocated primary trust-scores $Trust_{min}$.
C. Just like mentioned within an upper segment, as soon as a product has been prepared to exchange, a prime manufacturer produces the TX_{cr}, thus this has been linked via identification concerning eminence brilliant agreement $ID_{contract}$, as well allocates CID for an item.
D. After the TX_{cr} has been saved within a record, TX_{sens} exchanges signifying a product's thermal reading states are saved at BlockChain, furthermore, warnings have been sent assuming that thermal stats surpass the limitations described within an agreement.
E. A controller periodically evaluates the essential maker's storage capacity, and the specific $Rep_{reg}(t)$ has been saved within animportantproducer'sreport [31].
F. ATX_{tr} barter has been used to exchange products betwixt the important creator along with a conveyer, the one becomes goods' latest owner. Taking into account the character considering an obtained produce, a conveyer assigns a necessary manufacturer the ranking $Rep_{trader}(t)$.
G. A rating spectacular agreement is triggered by the exchange TX_{tr}, which records $Rep_{sens}(t)$ along with an important producer's assessing R_{seller} as well as keeps all independently within a product also an important producer's reports.
H. Trade flanked by a conveyer along with a trader is rehashed by replacing an important maker as well as a conveyer along with a conveyer as well as the transporter and the trader in dependently. A trader has been a product's most recent purchaser [32].
I. Finally, the shop sends out TX_{rec}, which generates product ratings based on the quality brilliant agreement.
J. For an exchange event occurring at time t, stages 1 to 9 have been repeated with regards to various products considering comparable nature, and a

merchant includes [$\text{Rep}_{\text{seller}}(t_n), \text{Rep}_{\text{seller}}(t_{n1}), \ldots, \text{Rep}_{\text{seller}}(t_0)$] to every item kind. Controllers, as well as executives, may request that $R(t_n)$ along with $T_{\text{trader}}(t_n)$ be registered and accumulated within the merchant's summary [3].

K. Based on the relevant trust values, a merchant is either penalized or rewarded. Purchasers of the things may ask Rep_{sens} questions to check for temperature limit violations along the item chain. Executives and controllers might ask a variety of questions about origin, item chain, and the merchant's reputation [33].

3.3 Evaluation of Execution

Calliper, a benchmark device that measures Hyperledger execution, is used to evaluate the verification of concept execution in Sect. 4. This lets Hyperledger clients quantify a presentation with regards to the BlockChain prototype with the use of inactivity and throughput likely to be bounded. Caliper, on the other hand, offers a finite quantity of preset arrangement prototypes for examination [34]. With regards to the TrustChain, here using the fundamental architecture that includes a performance requested hub and two underwriting peers from separate organizations, each with its communication channel [35]. On a Dell Notebook, the overall trade system has been shown using Hyperledger-Composer, along with implementation examinations have been completed using the Caliper instrument (Intel Core i9, 4.2 GHz, 32 GB memory).

We choose the Tx_{cr} and Tx_{tr} exchanges in TrustChain for the presentation evaluations since they are continuous and have greater computational overhead. Without trusting the executives, we consider a benchmark BC architecture that only maintains ownership data of production network events. We then offer a presentation that compares the TrustChain to the benchmark BC architecture by looking at the Tx_{tr} exchanges as they are [36]. We employ Tx_{tr} exchanges to register the above of our trust in the executive's framework since these exchanges conjure the trust in the board framework's rating dazzling agreements [37].

Outbreak	Explanation	Safety	Outbreak possibility	Outbreak conflict
Instrument interfering	An assailant/untrustworthy merchant tries to tamper with the sensors so that they produce accurate data	We are reliant on present approaches for sealing the sensors	Likely	Maximum
Instrument provender alteration	During correspondences, an adversary tries to change the sensor feed	Between the sensor gadget and the entrance, the sensor data may be jumbled using a split key	Likely	Maximum

(continued)

(continued)

Outbreak	Explanation	Safety	Outbreak possibility	Outbreak conflict
Assault on white washing	An untrustworthy merchant's attempts for fixing its bad faith result in reentering a structure under the different characteristics as well as acquiring $Trust_{min}$	(i) Through the focal power, merchants have been listed in an authorization system (ii) In the case of a disavowed personality, merchants may re-join with the permission of the organization's management	Dislikely	Maximum
Identity out break	An aggressor creates many identities and attempts for using those to maintain control over the standing count	Members of the merchant community are unable to adopt distinct personas	Dislikely	Maximum
Assault on a polling form: incident 1	An untrustworthy trader tries to create deceptive deals with himself in order to elevate his status	Due to access control restrictions, a merchant is prohibited from trading with oneself	Dislikely	Maximum
Assault on a polling form: incident 2	An untrustworthy merchant joins together with other merchants to fabricate things that do not exist in order to boost his reputation	(1) Every exchange is tied to a specific item, and the existence of unacceptable ware could be identified because an item sequence wouldn't be finished if a product isn't exchanged [36] (2) A business organization's inspector can identify a merchant with multiple out-of-date beginning exchanges and reject the merchant or lower his standing score	Likely	Maximum

(continued)

(continued)

Outbreak	Explanation	Safety	Outbreak possibility	Outbreak conflict
Assaulting castigating	A merchant, either alone or in collusion with other merchants, tries to smear a genuine broker in order to lower his reputation	In the event that the merchant detects an untrustworthy customer, our system includes a disappointment banner for the customer. Validators may see the disappointment banner associated with a merchant to identify untrustworthy merchants [38]	Likely	Modest
Burglary via pantomime and infamy	A merchant attempts for stealing the ID of a different broker and also assumes his position	The corporate system administrator reactivates network enlistments thereafter, this may need verification of distinguishing evidence	Dislikely	Maximum
Exchanges are cancelled	A merchant may refuse the occurrence of a production network event or the delivery of production network information	Exchanges upon BlockChain guarantee the consistency of information as well as the availability of exchange opportunities, along with the information's resource	Dislikely	Maximum

Then, for a reproduction time period of seconds, we give the throughput and inactivity execution evaluations, which fluctuate an exchange dispatch pace of Tx_{cr} as well as Tx_{tr} by 10–100 exchanges each moment (t_{ps}). The results of an assessment have been attained with an average of ten sprints for each transmit speed to every deal kind [39].

3.4   Trust-Chain's Throughput Performance

The pace at which exchanges are concentrated on the record after being provided by a merchant is known as throughput [40–42].

Exchanges of goods: Tx_{tr} has been a very costly TrustChain exchange since this comprises registering a Rep_{seller} as well as updating the product responsibility [43]. Figure 4 shows the throughput analysis of Tx_{tr} in the benchmarks BC and TrustChain. We can observe that the Trust chain's additional above is in the request for a few minutes, resulting in the benchmark framework's throughput increasing through almost 6-exchange on 75 t_{ps}. Figure 4 again illustrates just as throughput increases in a straight line until it reaches its maximum at roughly 45 t_{ps}, after which it starts to decline. To cope with the growing currency rate, it has been addressed as an engagement tip to an approved companion [44]. This pattern resembles a congested network blockage, with the organization subsiding within the condition wherein this generates tremendously poor throughput, excessive parcel hardship, as well as a significant increase in bundle postponements after reaching an immersion point [45]. The benchmarking framework shows a similar trend, with throughput starting to decline at 45–55 t_{ps}.

Make a trade: Look back on Sect. 3.2 to every TX_{cr} results in the creation of a new product. Tx_{tr}, on the other hand, is renewing the scenario with recently created items and member renown ratings [46]. It prevents the approval of additional assets when an item is registered on the organization in this way. Figure 6 demonstrates that for TX_{cr}, the growing trade sends charge obstructs an authenticator about 35–40 t_{ps}, which is a little earlier than for Tx_{tr}. It would seem because of an unanticipated setback caused by asset approval into the Tx_{cr}, resultant the significant idleness in considering Tx_{cr}, as in-depth within a subsequent segment [47].
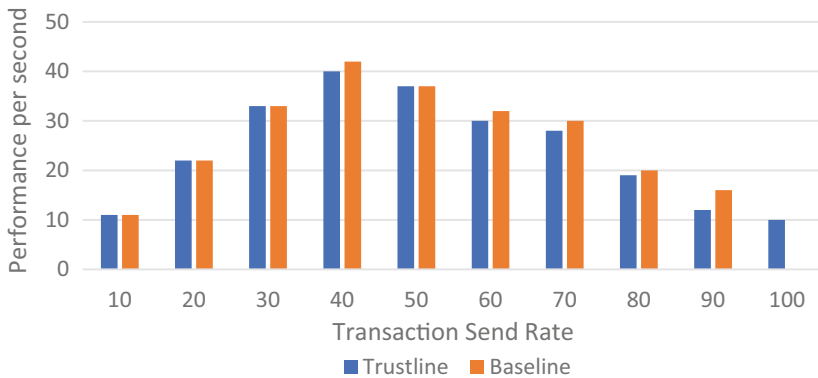
Fig. 4 Examining typical performance

3.5 Trust-Chain's Inactivity Performance

Dormancy is the duration between an application submitting an exchange and the committing peer in Hyperledger focusing on the record [48]. Underwriting inactivity, broadcast dormancy, committing idleness, and requesting inactivity are all examples of exchange inactivity. Caliper, on the other hand, just provides the total postponement, not a detailed split of the previously described components [10] (Fig. 5).
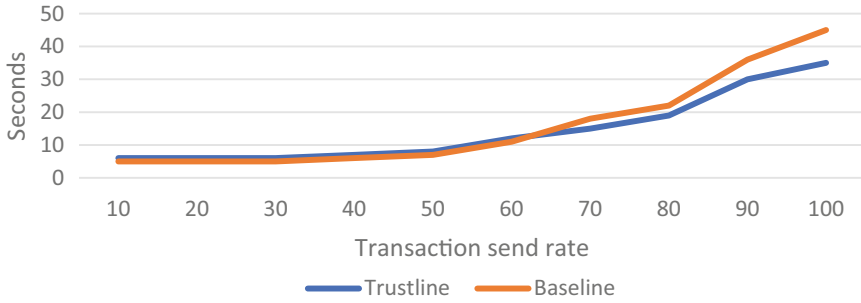
Fig. 5 Normal inactivity and its correlation
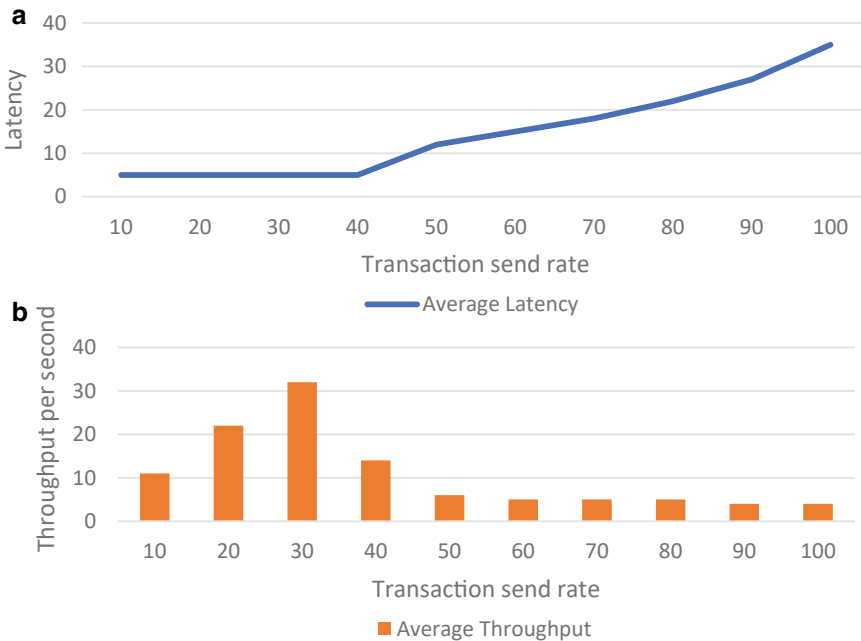
Fig. 6 **a** Average latency. **b** Average throughput

Tx$_{tr}$ and Tx$_{cr}$, respectively, indicate usual inactivity in Figs. 6 and 7a, b. As can be seen in Fig. 6, TrustChain's usual inactivity is somewhat greater than the benchmark [49]. Note that just as soon as a trade transmit pace reaches else approaches a captivation threshold concerning the most severe throughput, idleness fundamentally increases for both exchanges. That has been because of the clog formed through the ascension of the amount of arranged exchanges queuing within an approval line, this causes an exchange to commit idleness, adding to the enhancement of typical dormancy [50]. Provided the Tx$_{cr}$, an increased exchange send rate chokes the validator when the additional asset is accepted, causing delays such as exchange underwriting idleness. This affects overall idleness, and throughput decreases. Figure 7 indicates that when inactivity increases to its maximum, the throughput to create fresh items reduces.

As a result, we may need to distribute the exchange load among an appropriate arrangement of validators, depending on the exchange send rate in a certain area of production network movement [51].

4 Conclusion

To address the problem of trust connected to the nature of goods and substances recording information on the blockchain, we presented a trust in the executive's structure in this article for blockchain-based production network applications. The TrustChain configuration makes use of an association blockchain in the tracking of the conversations across manufacturing system associates besides gradually diminishing trust as well as dishonor ratings as a result of these partnerships. The structure also helps to provide a professional and resource-based standing model, the ability to relegate item unambiguous notorieties for a comparable member, and the achievement of computerization and effectiveness via brilliant agreements. We conducted a subjective security assessment of the threats in standing frameworks. The additional overhead provided by Trust-chain is small, according to an implementation investigation in proof-of-concept implementation using Hyper-ledger. Later on, we'll look at what the various consortium organization types might entail for the framework's normal throughput and inactivity.

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Supply Chain Management Using Blockchain Security Enhancement

Aditi Sharma, Vishal Goar, Manoj Kuri, and Chiranji Lal Chowdhary

Abstract The cybersecurity of contemporary systems has drawn much more focus from both academic and industrial viewpoints. The blockchain-based approach has recently become more popular due to how straightforward it is, especially in the management of supply chains. This highlights how crucial the quality factors are from a supply chain management standpoint. Numerous sectors have come to realize how crucial it is to have reliable supply chain and logistics solutions. The introduction of blockchain technology has given rise to several possible breakthroughs in the management and monitoring of corporate operations, specifically supply chain procedures. The blockchain and, more precisely, a smart contract technology that was utilized to manage the process of creating, verifying, and inspecting data over the supply chain management process were both discussed in this study. Next, discuss blockchain cybersecurity in the context of supply chains. Security protection needs to be powerful sufficient to shield the assets and data from dangers, as the smart contract increasingly controls the movement of data over many places. The paper then examines the primary security breaches that have an impact on the data on the blockchain and offers a fix.

Keywords Blockchain · Supply chain management · Tamper-proof data · Sybil attack · Smart contract · Eclipse attack · Majority attack

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1 Introduction

The blockchain-based approach has recently become more popular due to how straightforward it is, especially in the management of supply chains. Primary flows—the flow of goods, processes, information, and money—is essential for the successful global supply chain management. Additionally, it is employed to neutralize any potential dangers and guarantee sector alignment. Nowadays, technical advancements have made it simpler and faster to transport goods or full cargo across the globe. Many businesses now maintain and keep an eye on their own IT systems for supply chain operations. However, it is still challenging for those systems to collaborate and offer a comprehensive picture of the dispersed supply chain systems.

A promising approach will be to construct and maintain supply chain management using decentralized ledgers like blockchain technology [1]. All blockchain transactions are completed using a digital method, where data is saved, verified, and checked on the network without a central authority's approval.

The blockchain offers various advantages and disadvantages in terms of security and transparency because all the data is kept in dispersed nodes [2]. This study examines how supply chain management operations are supported by blockchain technology [3], improving the procedure, ensuring data security, and ensuring cost-efficiency. This paper's main contribution consists of:

- Research the current issues with blockchain-based supply chains and provide solutions.
- Express security reservations about the use of blockchain technology in supply chain operations.
- Make recommendations regarding typical attacks on blockchain technology and their effects on supply chain operations.

2 Literature Review

2.1 Blockchain Technology

Blockchain is a peer-to-peer distributed ledger with cryptography at its core [4] that enables the generation of safe transactions eternally free from outside interference [5]. At least 51% of the network's nodes must validate each block [6]. There are other ways to achieve unanimity, but the four most common ones are Proof of Work (POW), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT), and Delegated Proof of Stake (DPoS). PoW is most frequently utilized in the Bitcoin and Ethereum platforms. To demonstrate the veracity of the data, the PoW strategy solves a puzzle [7]. It is necessary to solve the puzzle and conduct all financial transactions; this procedure is known as "mining" [8]. A block is added to the blockchain once the data has been proven, at which point it can be generated and given a hash number that ties it to the preceding block [6]. The block will subsequently be transmitted to all

network nodes [6]. The data is encrypted and can only be decrypted by the intended persons involved, even though it is publicly accessible to anybody with access to the blockchain. Blockchain-based encryption uses asymmetric keys. In other words, the key used to encrypt and decrypt the data is different. The public and private keys were made by mathematically connecting the two keys. The intended receiver within the network will utilize their private keys to decrypt the data, while the public key is used to encrypt and confirm the overall transactions [9]. As a result, the blocks built into the chain are secure from a confidentiality standpoint, unchangeable, and their integrity is unharmed.

Blockchain mostly concentrated on Bitcoin and decentralized cryptocurrency and payment exchange. After that, it underwent an evolution known as Blockchain 2.0, which was introduced in 2013 and focuses on decentralizing the entire market and transferring data and assets via smart contracts. Ethereum is an open, decentralized platform that powers the majority of smart contracts in use today [10]. A smart contract is a digital contract that enables the execution of business transactions securely based on the triggering of an action based on predetermined parameters [6, 11]. High-level programming languages like Solidity, LLL, and Serpent are used to create it. Solidity is the most widely used programming language. The business rules will then be run by the code via the Ethereum Virtual Machine ("EVM") [7] [10]. To prevent contracts from being modified, each newly formed smart contract will be copied to every blockchain node [10].

2.2 Supply Chain Management

Because of the developments in global industries, people's perspectives on the supply chain have altered recently. The supply chain stakeholders are currently dispersed throughout the nation or even outside, making it impossible for the industries to compete effectively. In recent decades, there has been a sharp increase in the trend of having effective supply chain systems in place. The history of supply chain management may be traced back to the early days of the garment industry, where a rapid response strategy was used, and later to the successful consumer responses in the supermarket industry [12]. the supply chain definitions have been offered in recent years as businesses have recognized the growing popularity of the idea. Supply Chain Management, according to Gao Z and his study group, is a cooperative method of business activities from end users to the original goods or product providers [13]. Additionally, it is described as "the complete method from producing the raw resources through to the final consumption of the finished products" in the APICS Dictionary (p. 13). The ordering and receiving of raw materials or finished goods, supporting customer services, and performance evaluations make up a typical supply chain management process. To provide timely and effective responses to supply chain events, the management of numerous services and processes across the company is necessary [13]. Typically, logistical services are crucial to providing consumers with the desired values. In the context of supply chain management, logistics' primary goal

is to obtain suitable things in good condition, delivered at the proper time and priced reasonably Value, dependability, swiftness, adaptability, and pricing are frequently used to gauge the SCM's performance.

The reduction of process risk is one of the main goals of supply chain management, which is a complicated process by nature. Two categories—holistic and atomistic—have been used to classify the sources of hazards in the SCM. To quantify the risk linked with the total source of risk, a supply chain process study is required. Compared to complex, uncommon, and expensive components, this type is strongly favored. The atomistic approach, on the other hand, focuses on picking a particular step in the supply chain process to assess the risk involved. It is strongly preferred over readily available, low-value, and low-complexity components [14].

Even though many businesses support the concept of effectively managing the supply chain, this new industry is still growing at a slow pace. The primary causes are primarily attributable to a lack of rules for creating proper agreements with supply chain participants, a lack of legal protection to maintain supply chain security [15], and a failure to develop adequate mechanisms for evaluating the agreements. Lack of trust both inside and outside the firm is another issue. Lack of interconnected electronic business networks and information systems [12]. Supply chain management is one of the numerous tasks that the blockchain can do and should be given special consideration [16].

2.3   Blockchain-Based Supply Chain Management

Many of the present operational challenges can be overcome, and there are many advantages to using blockchain in a traditional supply chain process as well. First off, the conventional. Because each party in the supply chain uses a centralized database to run its operations, there is a lack of visibility between the parties. Since there is little transparency in the supply chain's activities, it also presents other problems like trust and security. The flow of materials or information between the various parties will become more erratic as a result. Furthermore, because data can be changed easily, the current system is inadequate at demonstrating its adherence to rules and regulations. If the finished product is not up to par, this may result in serious health, safety, and environmental harm [2].

By making the transactions accessible to all interested parties in the public, blockchain technology will solve the visibility problem. Additionally, because the system is independent and not in the hands of a third party, the blockchain will uphold the parties' faith in one another. The public-key infrastructure, which uses immutable data blocks, makes data interchange secure. Secure against adversary manipulation and guarantee adherence to rules and laws as a result. The use of blockchain technology in the supply chain is suggested as a solution by the research study [17] to increase chain security and transparency. Because of this, applying blockchain technology to the supply chain will make its operations quicker, stronger, intact, secure, and more trustworthy [9, 18].

For creating a supply chain that uses blockchain technology, [19] suggests a business model approach. The prospective use cases and important concerns, such as the value proposition for data integrity, security, ownership, and privacy, were discussed in the model. The use of blockchain technology to streamline and strengthen the supply chain management process in some industries, including food, medicine, and education, is heavily discussed in the literature on distributed nodes. Few studies also look at blockchain technology from a security standpoint. The research report, however, goes into detail about how connecting blockchain in the context of a supply chain affects security.

2.4 Blockchain-Based Supply Chain Management Versus Traditional Supply Chains

Finding the key players is the first stage in implementing the supply chain management plan [20]. Because this strategy strives to maximize value throughout the entire supply chain network [21]. From end users to suppliers of services, goods, or information, SCM is essential to the logistical operations of other businesses. The traditional SCM process is placing or receiving orders for raw materials or finished goods, offering auxiliary services to customers, and tracking supplier performance [13]. On the other hand, before reaching suppliers for product delivery, the cash flow process will first pass via customers. Information will also circulate frequently among suppliers and clients. For both parties to be aware of how effectively or poorly their connection is progressing, the right information must flow. Any firm must undoubtedly coordinate a variety of activities to react to supply chain management events swiftly and successfully. Figure 1 illustrates the role that the supply chain plays in the business process. It provides the necessary tools for diverse jobs and is in charge of directing the information flow [13]. Since supply chain integration is an ongoing concept, the organization must put out the constant effort.

Supply chain procedures can implement blockchain technology by using smart contracts. The initial participants in the blockchain network should be the supplier, manufacturer, distributor, storehouse, and retailer. In addition to finishing a task, a party also adds a new block onto the blockchain each time. Each block becomes a part of the blockchain when it is linked to the block that originated from the last person in the chain to accept responsibility. Data accumulates, as a result, making it easy to locate and trace.

The process starts when a supplier provides the company with the raw materials they requested. A new block that is uploaded to the blockchain will have the raw—materials data, which includes the proof of origin, batch details, order number, delivery date, and barcode. The smart contract is activated when the producer obtains the raw ingredients, and it checks the delivery against the needs, quantity, and quality indicated in the order. If the raw materials are delivered by the request, the smart contract will begin processing the payment for the supplier. The next step is for the
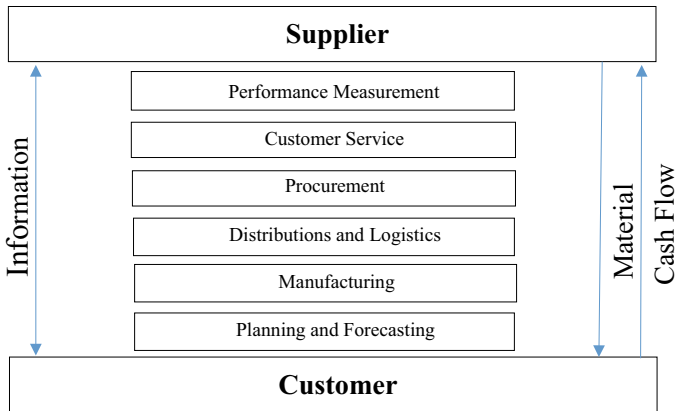
Fig. 1 The functions of supply chain management

producer to produce the goods using raw materials. Once the products are ready for distribution, a fresh block with the preceding product details supplied mostly by the supplier and the manufacture's number will also be inserted into the blockchain. The recently inserted block will be linked to the chain's previous block using the hash value. At this time, the products are being readied for shipment to the warehouses.

The blockchain will receive a new block when the products are sent, along with the previous data and the shipment number. Another smart contract will be activated once the shipment reaches the warehouse and will match the supplier, order, invoice, and shipping, and check the quality and amount. If approved, the smart contract will start the process of paying the manufacturer and the warehouse's inventory level will be updated. The warehouse will then send the requested products to the store by their request, and it will also add a new block to the blockchain with the previously mentioned information in addition to the product received data, shipment date, and packing barcode. A hash value will be used to connect the new block to earlier blocks. Another smart contract will be activated when the retailer receives the package to verify that it is by the order.

If so, a smart contract will start processing the payment and updating the inventory levels. The store will then add a new block to the blockchain, connected to earlier blocks by a hash value, that contains the receive date, order number, and customer ID. The final consumer can then quickly scan the product's barcode to determine where it came from.

3   Security of Blockchain in Supply Chain Context

This section explores the benefits and drawbacks of using blockchain technology in supply chain operations.

3.1 Tamper-Proof Data

A timestamp for every block added to the blockchain is crucial in the context of the supply chain because several parties are involved throughout the process. The timestamp guarantees data integrity and prevents any further alterations. Traditionally, a trusted server using the user's private key applies the time stamp mechanism to the blocks. But if the server is compromised, earlier transactions might be signed and posted. Decentralizing and dispersing the timestamping can thereby solve the problem [22].

3.2 Single Point of Failure

Decentralization is one of the fundamental components of blockchain technology. All of the network's nodes hold the data in storage. Because every node will have a copy of the whole blockchain, the one-point failure problem won't exist. Additionally, even if one or more of the nodes are down due to maintenance, an upgrade, or a Denial of Service (DoS) attack, the data will still be accessible on the network's other nodes. The blockchain thus guarantees data accessibility. Additionally, as Ethereum is an open-source platform, its code is less likely to be altered maliciously because it is under the scrutiny of numerous parties. But just like any other piece of software, it could contain faults or weaknesses brought on by human error. Overall, ensuring data availability will improve the effectiveness of supply chain operations such as ordering the proper amount and timing of material, shipping the goods as soon as they are prepared, and optimizing the stock levels in the warehouses [22].

3.3 Privacy

The protection of data is crucial in supply chain management because Each party desires to prevent the exposure of its data. other participants in the chain and keep themselves competitive benefit [23]. Blockchain guarantees data privacy by public–private key pair (Asymmetric encryption). they are for each stakeholder to create a digital identity and the ability to manage real-time data access [23] You can exchange the keys within the blockchain by utilizing one of two Transport Layer Security suites (TLS), which is better: Elliptic Curve or Rivest-Shamir-Adleman (RSA) Exchange Diffie-Hellman (ECDHE). However, they are both the National Security Agency (NSA) discouraged in 2015. According to some studies, this is because of the rapid quantum and post-quantum eras of computing. Additionally, the blockchain's cryptographic building blocks are categorized into two broad groups: primary and optional. To increase the anonymity and the flexibility of blockchain-based transaction privacy. While the cryptographic hashes are in the primary category. commonly used digital

signatures that are crucial for ensuring the blockchain is an openly verifiable global ledger, attainable unanimity that is impenetrable [24]. Data security is encouraged by the hashing algorithm used to sign the blockchain transaction. Data security measures are based on the hashing algorithms utilized, such as Scrypt, SHA-256, and SHA256D, too. The hash function should be carefully chosen, though, according to how sensitive the data is. A stronger hash function may take longer to perform transaction signatures, which could slow down the entire supply chain [22].

3.4 Identity Management

Data confidentiality is ensured by supply chain stakeholder digital identity definitions since only authorized individuals can access the data. Therefore, managing digital identities can be done in a variety of ways. For instance, a research paper [25] offered the model using a clustering mechanism based on secure cryptography, which applies methods for signature generation and signature verification. To begin with, a single organization may be in charge of overseeing and issuing digital identities for the stakeholder (centralized approach). However, if the supply chain participants are dispersed across several nations, it will be the duty of each to create a digital identity for its national businesses. However, users themselves can manage their own identities (user-centric approach) [22].

3.5 Information Security

When implementing blockchain in the supply chain, data security must be preserved when exchanging information. This information security trinity is made up of confidentiality, integrity, and availability. Only authorized people will get access to the data thanks to confidentiality [26]. As a result, each party involved in the supply chain must safeguard their private key as the decryption of the data requires both public and private keys. The privacy of the data will be violated if the private key is made public or shared with unauthorized people in any other way. Blockchain can also aid in data secrecy because it shields users from IP spoofing and pirate threats [22]. On the other hand, data accuracy should be intact upon retrieval and should not have undergone any modifications [26]. Data integrity is guaranteed in a blockchain since each block contributed to the chain is signed and timestamped. Data is hence unchangeable. The data can, however, be altered in extremely uncommon specific instances by a procedure known as "hard forks," such as the DAO example [27], where a significant adjustment is required to validate the incorrect block. This will compel every node to update to the new protocol in their protocol software. The new system will no longer accept nodes that have not been updated. This will cause a fork or deviation, with one version being the outdated version and the other being the older, un-updated version [28]. Data integrity is essential to supply chain operations

since all party's decisions affect financial values and must be carefully considered and supported by accurate data. The ability to promptly obtain the data is what availability refers to [26]. Public blockchains guarantee data availability since every node on the network receives a copy of the entire ledger. The 51% attack, however, has the potential to jeopardize availability in private blockchains [22]. The number of miners operating in the private blockchain network determines the likelihood of this assault. The likelihood is larger if the network is small. If data is unavailable, it will be difficult for any supply chain actor to perform a commercial transaction, and if the private blockchain is completely relied upon, the entire process could become paralyzed.

3.6 Smart Contract Management

Smart contracts are essential for streamlining the entire supply chain process when integrating blockchain and supply chains. It is a section of code that runs in response to a particular predefined circumstance. According to the method outlined in this paper, the execution of a smart contract will cause the following process—the payment process—to be initiated. To avoid unauthorized modifications, all smart contracts are deployed and preserved in the blockchain. However, the strength of the smart contract's code determines how secure it is, as weak contracts are weak and can be taken advantage of by hackers. They must therefore be carefully written. Smart contracts' triggers can be manually set or they can be pushed by oracles from an existing technology with the appropriate stakeholder. Websites for businesses, RFID, and IoT are a few examples of this technology [22].

4 Possible Security Attacks in a Supply Chain Based on Blockchain

This section discusses the most common security flaws in peer-to-peer systems (blockchain) and how they influence supply chain management practices. These attacks aim to compromise network connectivity between the required nodes as well as data protection, integrity, and availability [29]. Therefore, when adopting blockchain technology for supply chain activities, these attacks should be considered and the system should be structured securely to minimize or reduce their impact.

4.1 Sybil Attack

The Sybil attack represents one of the most very well damaging attacks against peer-to-peer systems, such as blockchain. A user can launch an attack when they have total control over a significant number of fake IDs that exist within the network [30], which also causes false information to spread to new trustworthy nodes [29]. As a result, it can compromise data confidentiality and integrity. The blockchain network's weaknesses, such as how reasonably priced identity management is stated, how reliable the transactions are linked, and how secure the private keys are, have a big impact on the attack. Because of this, it is difficult to halt this attack, although its consequences can be mitigated by using good security measures.

As previously said, the right identity management process should first be designed and agreed upon by the participants in the supply chain The name ought to be secured, and the network shouldn't trust any internal identities unless they adhere to the established digital identity standards. Standards. Additionally, some literature advises restricting the network access to the value chain's participants and securing the network from unauthorized users as a result [30].

4.2 Eclipse Attack

As the main goal of this type of attack is to conceal and eliminate the genuine connections from the system, an entity assumes multiple identities to plan and obstruct traffic that passes through those nodes. This attack is aimed against a public internet address. Security is one of the core issues with peer-to-peer networks because of how decentralized they are. This P2P network is more prone to sophisticated attacks when compared to client–server networks. In this Eclipse attack, the attackers are in charge of a substantial portion of the nodes that are close to the good nodes in the network. As a result, they influence the majority of nodes and can modify the overlay network [29]. The legal users are isolated from the other linked nodes in the network as a result of the attackers' ability to manage all of their transactions and operations. Additionally, they can reorganize the user's perception of the peer-to-peer network and compel him to utilize energy in blockchain networks inefficiently. This kind of assault can result in Denial of Service, as described in the research paper [31]. Even while it is challenging to stop this attack, its consequences can be diminished by putting the appropriate security measures in place, like blocking access to a blockchain network to those who have high degrees of authorization. Because no one will be able to discover the data or confirm its provenance or that of the resource base, which would lead to a large financial loss, eclipse assaults jeopardize the availability of data, confidentiality, and integrity. As a result, they have one meaningful impact on supply chain management.

4.3 Majority Attacks

One of the significant cyberattacks against the blockchain is the 51% attack, also known as the majority attack. Its mechanism relies on a hacker's capacity to seize control of the majority, or more than half, of the network's nodes to create a fictitious consensus in the voting system. Since he lacks access to the participants' private keys, the hacker is unable to alter the data that has already been stored in the blockchain. The attacker might, however, add fresh fault blocks to the chain [32]. Since there are so many nodes in a public blockchain, this attack is seldom ever carried out there. Private networks are hence more susceptible to this assault [31].

As a result, network users regard the PoW power and electricity usage of the nodes that are controlled by hackers to be a cost. The cost of an assault increases with duration [32]. Data availability, integrity, and secrecy are all compromised by this assault. As a result, it could result in financial losses for supply chain stakeholders. Additionally, because the information flow won't be available, it will be challenging to carry out commercial operations like purchasing, shipping, and executing quality control procedures.

The article advocates the application of blockchain technology in supply chain management as a sustainable and secure method that will assist to optimise the overall effectiveness of supply management procedures based on the analysis of blockchain technology and security concerns. The difficulties that traditional supply chain management systems confront would be better addressed by the use of blockchain. Additionally, the supply chain process can make use of the Ethereum platform's smart contract capabilities [33] to monitor and manage the chain's operations with dependable distributed applications and enhanced cryptographic security.

5 Conclusion

This paper described how the blockchain-based supply chain can optimize supply chain operations along the entire value chain and how smart contracts on the Ethereum platform can support end-to-end supply chain processes. It also identified the difficulties and their effects on the traditional supply chain process. The research also looked at the advantages and drawbacks of the blockchain's use in supply chain management for cybersecurity.

The report also looked at the consequences of the primary blockchain security assaults on supply chain operations, and it made recommendations for how to create supply chains that are both secure and sustainable. Additional security and interoperability concerns need to be taken into account for future studies, as firms are presently exploring using cloud-based blockchain technology for the supply chain management.

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A Novel Image Encryption Algorithm Using Logistic and Henon Map

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Abstract Image encryption is a method for efficiently hiding the image's valuable characteristics/contents. Chaotic maps are commonly employed in the encryption of systems that are dynamic. The main qualities of Chaotic Maps that make them effective for Image Encryption are that they are extremely sensitive to the initial values of their parameters; even a minor change in these parameters will result in a big change in the end output. Using chaotic/Logistic Maps, we research and develop new/improved ways to encrypt images. The suggested approach tries to provide information security by encrypting images with chaotic maps. The inclusion of chaotic methods in the encryption makes decrypting the image more challenging for attackers.

Keywords Image encryption · Chaotic maps · Logistic map · Henon map · Image security

1 Introduction

1.1 Overview of Image Encryption

In recent years, there has been a tremendous advancement in the realm of technology, particularly in the area of picture encryption. In this environment, safety has always been a priority. Security is a rapidly expanding field of study. The content/data security is a big problem. Images are an important part of the data/content. Image encryption is a technique for ensuring the security of images by employing algorithms [1]. These techniques necessitate the use of random key generators. Maps that are chaotic. Compressive sensing, optical, transform domain, and spatial domain are the four basic types of image encryption techniques [2]. Compressive Sensing is a signal processing technique that finds solutions to indeterminate linear systems in

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order to quickly acquire and reconstruct a signal [3]. Optical uses the optical properties of images to encrypt them, some examples are Position Multiplexing, Phase Truncation Method, Lateral Shift Multiplexing, Multibeam Interface and Amplitude Face retrieval. Transform domain uses transforms examples include Wavelet Transform, Gyrator Transform, Fraction Fourier Transform, Fresnel Transform. Spatial Domain is the normal image space. These types of image encryption algorithms work on image space. Examples are using Meta heuristic, chaotic Maps, Elliptic Curve, Cellular Automat, DNA, Fuzzy, etc [4].

1.2   Chaotic Maps

Chaos theory explains the way nonlinear dynamic systems behave and how much they are affected by the starting circumstances. The main characteristics of chaotic systems are their sensitivity to initial conditions as well as their mix- ing properties. There are various types of chaotic maps such as:

Logistic Map It is recursive relation comprising of two parameters and an illustration of how simple nonlinear dynamic equations may lead to complex chaotic behaviour. Mathematically it is represented as:

$$U_{n+1} = r \times U_n(1 - U_n) \tag{1}$$

where the parameter U lies in interval [2, 4] and parameter r lies in interval [0, 1]. The simplicity of this map is the reason to consider it for a point of entry into the chaos idea. It exhibits a high sensitivity to the starting circumstances which is a characteristic property of logistic map for most values of r lying in range of [3.57, 4]. Figure 1 shows the bifurcation diagram of the logistic map, U is represented as x.

Fig. 1 Bifurcation diagram of logistic map
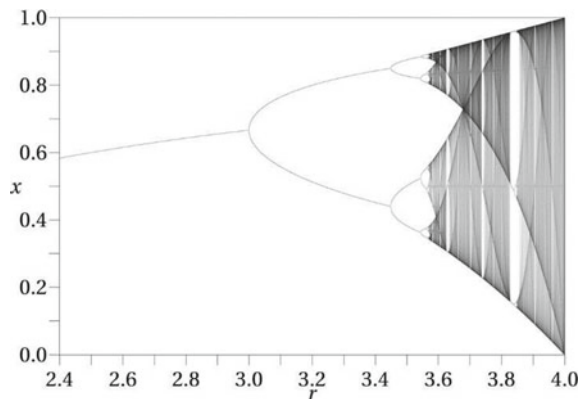
Fig. 2 Orbit diagram of Henon map with b = 0.3
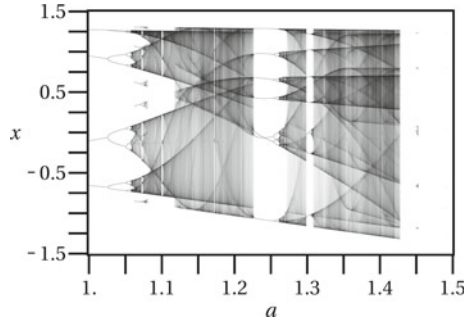
Henon Map The Henon Map is a discrete output based map which is dynamic in nature. It is used to generate chaos as it exhibits the three important Characteristics/Properties of chaotic Systems which are area preserving, bounded, deterministic. It gives us a point corresponding to point (l, m) as (Figs. 2 and 3):

$$l_n = 1 - al_n^2 + m_n \tag{2}$$

$$m_{n+1} = bl_n \tag{3}$$

2 Image Encryption Algorithm

We have proposed an image encryption algorithm using both chaotic maps logistic and Henon Map. Logistic Map is used for encryption procedure, Henon Map is used for Pixel Scrambling. Equation for Calculating Sum of an Image is:

$$sum = \frac{i \sum_0^{height} j \sum_0^{width} img[i, j]}{height * width * 255} \tag{4}$$

Here img represents 2D matrix of Image, width is width of Image and Height is Height of Image. Steps of Image Encryption Algorithm:

Step 1 Take the Input Image I of size M × N .
Step 2 Convert the Input Image to grayscale i.e I to I′.
Step 3 Generate the chaotic sequence S of size M × N using (1) taking X0 as sum calculated from (6) and r = 3.99 for chaotic behaviour.
Step 4 Rows Scrambling is done by generating chaotic sequence from (4) (5) with a = 1.4 and b = 0.3 for chaotic behavior, multiplying the value to 10^{14} and taking mod 256 will give us no. of rotations for that row and each row is rotated either right if it is odd indexed or left if it is even indexed.

Fig. 3 Image encryption algorithm
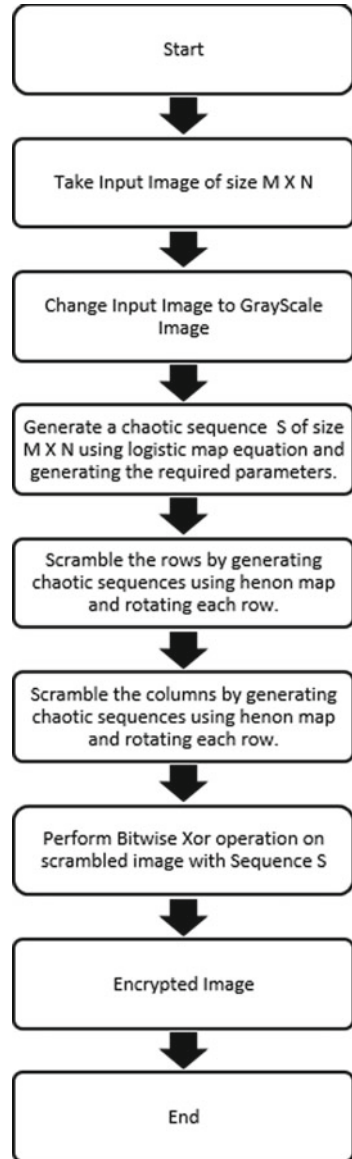
Step 5 Similar to Row Scrambling , Columns Scrambling is done by generating chaotic sequence from (4) (5) with a $= 1.4$ and b $= 0.3$ for chaotic behavior , multiplying the value to 10^{14} and taking mod 256 gives us no. of rotations for that column and each column is rotated either down if it is odd indexed or up if it is even indexed.

Step 6 Perform Bitwise Xor Operation on the scrambled image with corresponding index of chaotic sequence S, to get Encrypted Image E. i.e $E = I'$ S.

Decryption Algorithm is reverse of the above mentioned Encryption Algorithm. All operations are reversible [5, 6].

3 Results

3.1 Key Analysis

The number of possible keys necessary to encrypt an original image is referred to as key space. The keys in this algorithm are X0, r, a, b. Figure 4 is original image, shows how the original image is turned to an encrypted image Fig. 5, using beginning values as x0 = 0.1 and r = 3.99. Even with a tiny variation of 0.00000000099 in x0, the decrypted image, Fig. 6, is not the same as the original image when using incorrect keys. It demonstrates that the image is only decrypted with the correct key using this approach.

Fig. 4 Original Lena grayscale image
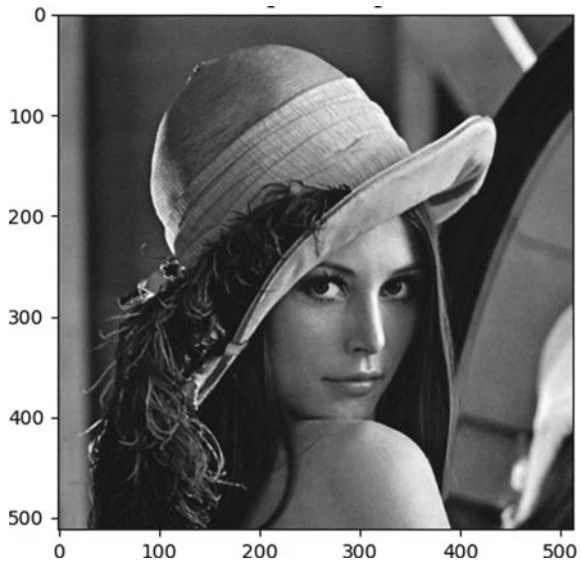
Fig. 5 Encrypted Lena
grayscale image
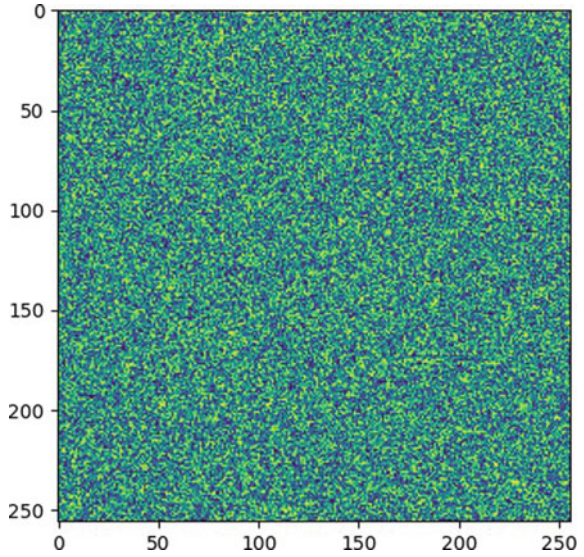
Fig. 6 Incorrect decrypted
image
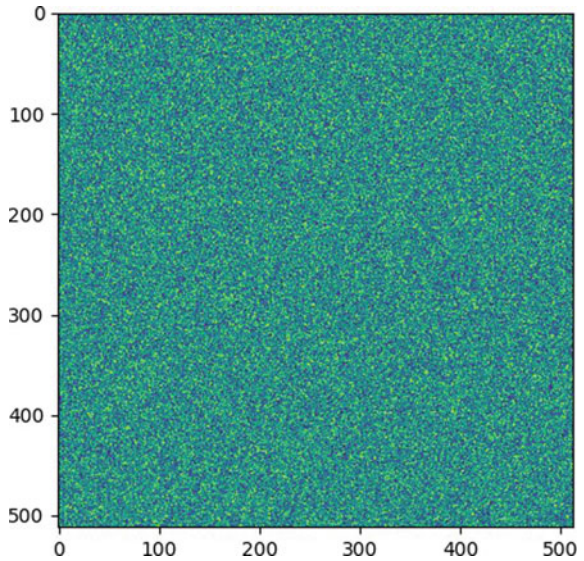
3.2 Histogram Analysis

A histogram is a graph that depicts the frequency of intensity values in an image. It depicts the intensity value distribution of pixels. Figures 7 and 8 show the histograms of the Lena image and the encrypted image, respectively. It demonstrates that after

Fig. 7 Histogram of Lena grayscale image (.tiff)
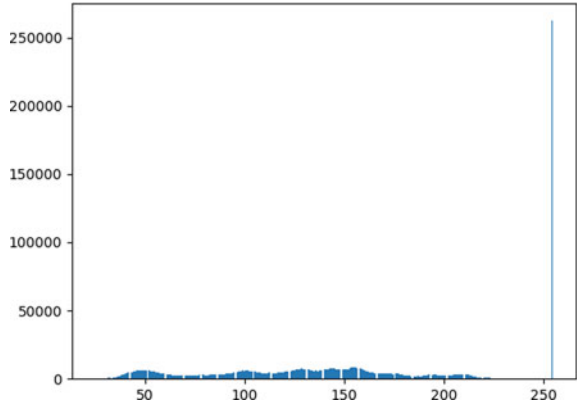
Fig. 8 Histogram of Encrypted Lena grayscale image
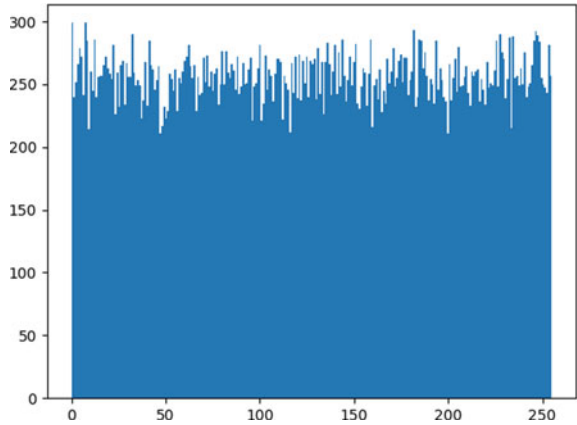
applying the given approach to a picture, the histogram of an encrypted image changes dramatically.

3.3 NPCR

The absolute number of pixels change rate is measured by NPCR. It is an test to measure the robustness of image encryption algorithm against differential attacks.

It is calculated as:

$$NPCR = \frac{\sum_i F(x, y)100\%}{wh} \qquad (5)$$

$$F(l, m) = \{0 \, if \, K_1(l, m)K_2(l, m)1 \, if \, K_1(l, m) = K_2(l, m) \qquad (6)$$

Table 1 NPCR and UACI values between encrypted images

Name of image	UACI	NPCR
Lena grayscale image (.tiff)	33.299	99.589
Cameraman image (.jpg)	33.41	99.621
Building image (.jpg)	33.40	99.60

Here w is width of the Image and h is Height of Image. K1 and K2 are Ciphered images. Values of NPCR for various sample images are depicted in Table 1.

3.4 UACI

When the change in one image is subtle, UACI computes the average difference in colour intensities between the two images. It is an test to measure the robustness of image encryption algorithm against differential attacks. It is calculated using following equations:

$$UACI = \frac{\sum_{lm} |K_1(l, m) - K_2(l, m)| \times 100\%}{T \times w \times h} \tag{7}$$

Here K1 and K2 are Ciphered Images. T stands for maximum gray pixel value possible, w and h stands for height and width of image respectively. Values of UACI for various images are depicted in Table 1.

3.5 Information Entropy

Information Entropy measures the value of randomness in the information data. It is calculated as:

$$Entropy = \sum_{i=0}^{r-1} P(K_i) \log_2 \frac{1}{P(K_i)} \tag{8}$$

Here K_i means the pixel values and $P(K_i)$ means the probability of K_i, r means total number of unique values which in case of a gray image is 256. From the results we got in Table 2, it is seen the entropy of encrypted images is very near to ideal value of 8, This means that the suggested image encryption algorithm has very little information leakage and is resistant to entropy-based attacks.

Table 2 Entropy values of encrypted images

Name of image	Original entropy	Encrypted image entropy
Lena grayscale image (.tiff)	4.722	7.9965
Cameraman image (.jpg)	7.07	7.99709
Building image (.jpg)	7.753	7.9994

4 Conclusion

This work proposes an image encryption technique that alters the pixel value of an image by changing the position of the pixel value, which is analogous to the confusion-diffusion qualities of cryptography. The following are some of the benefits of the proposed scheme: The technique can withstand attacks that occur during transmission, it is secure because the picture is only decrypted with the right key, and it is highly resistant to differential attacks.

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An Analysis of Data Sparsity Resolution Algorithms Used in Recommender Systems

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Abstract In previous years, a substantial rise has been observed in the use of YouTube, Netflix, Amazon, and other similar web services that have enabled the utilization of recommender systems. Ranging from e-commerce to online advertisements, recommender systems tend to be unavoidable in routine journeys. Fundamentally, such systems are emphasized by suggesting relevant items to end-users and are of great use in enhancing the engagement rate. However, there are several problems such as Cold Start and Data Sparsity that impact the efficacy of the recommender system. A wide range of factors is responsible for such issues. In a similar context, this paper focuses on conducting a systematic literature review and analysis of different algorithms that have been proposed by researchers and practitioners in the field of recommender systems. The preliminary purpose of this paper is associated with obtaining an in-depth and succinct understanding of a wide range of solutions that have emerged from different studies. Based on the algorithms mentioned in the literature, it has been observed that Singular Value Decomposition Plus Plus offers the best possible resolution to data sparsity issues.

Keywords Recommender system · Collaborate-based filtering · Sparsity · Accuracy · SVD

1 Introduction

In the last decade, recommendation systems have assumed an important role in online social media, e-commerce, and entertainment platform such as LinkedIn, YouTube, Research Gate, etc. [1]. Earlier, it was very difficult to find a suitable and efficient recommendation for the users. With the development of technology, recommender systems have grown exponentially in various fields of information and web applications. The number of datasets is available pertaining to the recommender systems which facilitates in generating and different preferences.

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Recommender system is accumulation of effective tools that can be used for recommending future preferences of a set of products to consumers and appropriately predict the most probable items [2]. The recommender system consists of various approaches such as content-based filtering, collaborate-based filtering, and hybrid filtering. Collaborative Filtering (CF) plays a vital role in recommendation systems which can help to make recommendations based on users' interests and preferences by using the previous history. Most developers tend to utilize collaborative filtering as this technique provides the best preferences. To get efficient and appropriate preferences, different models have been encompassed in CF. Further, a large number of datasets is available that can potentially create data sparsity and scalability issues [3]. To analyze this problem and improve the quality of the data. Machine Learning techniques can be utilized. Further, recommender system and their techniques are discussed to make appropriate preferences as per users' needs. With the help of such techniques and models, better performance of the recommender system can be attained.

This paper has been fragmented into multiple segments, each of which potentially focuses on different aspects of Recommender System. The paper initiates with a fundamental and rudimentary description of recommender systems. Different types of systems have been thoroughly discussed in the primary section of the paper. Major classifications discussed in the paper include content-based filtering, collaborative-based filtering, and hybrid filtering. Further, the paper also emphasizes on the discussion of two major types of memory-based filtering which includes item-based filtering and user-based filtering. After a comprehensive description of the basic types of recommender systems, analysis and findings of data sparsity algorithms have been thoroughly discussed in the paper. Overall, the research paper provides a thorough and in-depth description about the concept of recommender system and the algorithms used for the purpose of resolution of data sparsity.

2 Related Work

In this section, we will discuss the recommender system and their types are discussed further in detail.

2.1 Recommender System: Classifications

Recommender system has evolved as a revolutionary concept that provides end users with the suggestions of information that would be highly useful to them [4]. The recommender system offers appropriate ways for providing personalized results. This system was predominantly employed in e-commerce and entertainment but nowadays it has grown in the field of research and academics. Fundamentally, recommender systems are those systems that predict the future of any items based upon
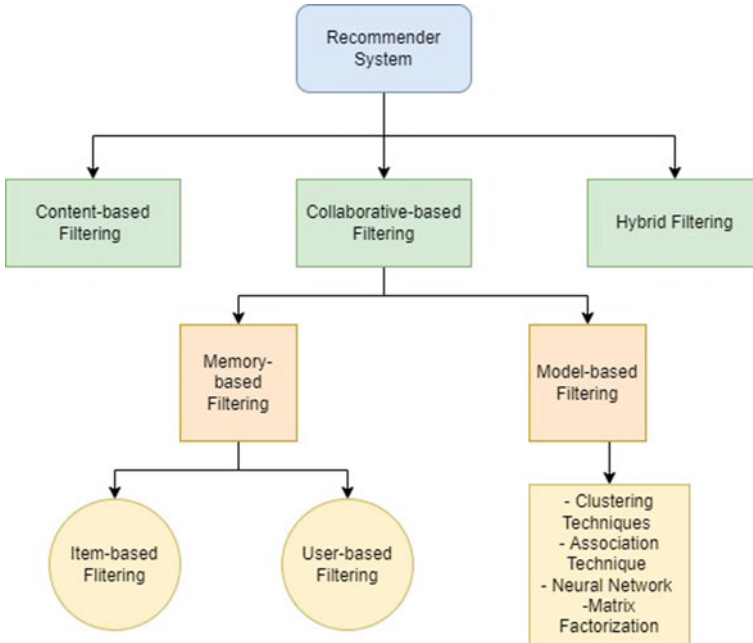
Fig. 1 Types and classifications of recommender system

the past behavior of end-user's [5]. In these days' machine learning introduced so many algorithms to predict recommendation as per previous preferences. All the classifications of recommender system are represented in Fig. 1 given and further explained in details.

2.2 Content-Based Filtering

The content-based recommender system is developed on single-user preferences. For example, on e-commerce websites, every individual tends to search according to their interest, and this user history is recorded as their past behavior. Further, the system examines the user's search history and then recommends similar choices to users [6].

2.3 Collaborating-Based Filtering

Collaborating is built upon users' historical behavior that including star ratings and reviews. This system used to build a frequent change in user's preferences. All your previous information is gathered over the internet then the system will make a

recommendation based on its analysis. This proves that collaborating filtering secures an important place in recommender systems [1].

Model-based collaborative filtering

This technique is beneficial for calculating the matrix factorization and this technique will be more efficient than memory-based collaborative filtering. Some Machine Learning approaches are included to make accurate predictions. Approaches include associate rule, decision tree, clustering, matrix techniques, etc. [7].

Memory-Based Collaborative Filtering

It entirely works with users' previous database to make a single prediction. For every single prediction, it consists of a preference database of user-item filtering and item-item filtering. A memory-based collaborating system is beneficial for making similarities between the two, due to the sparsity and scalability issue that comes under this scenario [7].

2.4   Hybrid Filtering

Different approaches are introduced in the recommender system and each of which has its functions and parameters. Still, there are some lags in the recommender system to improve for which hybrid filtering can be potentially used. Hybrid filtering is the merger of both content-based filtering and collaborating filtering and it works on system performance. The hybrid technique is used for resolving issues and enhancing the performance of the recommender system [8].

Althbiti et al. [7] the author has proposed item-based collaborative filtering and made use of the movies dataset to do a comparison between different clustering approaches. With the help of such approaches, the author wants to reduce the unpleasant data to remove the sparsity and scalability issues. A developer proposed a novel recommender system to improve the performance of reliability measures. This method is beneficial for collecting unreliable ratings and evaluating the results of reliability measures. In Anand and Bharadwaj [9], a simple approach is introduced to calculate the statistical classification of users' ratings and behavior. It uses both user-based and item-based which forms a hybrid approach and generates more accurate predictions that improve the performance time. In Guo et al. [10], a method is proposed to extract the unpleasant data to reduce the sparsity issues. As users tend to buy items based on personalized but improper and ineffective feedback could impact the process. To overcome this, the author introduced two methods: the first one is linear regression and the other is multidimensional similarities to tackle the sparsity data and make it reliable. An author proposed a technique particularly cross-domain and transfer learning to facilitate the similarity between distinct user profiles. Model-based and Memory-based collaborative filtering comes together to deal with the sparsity issue in the recommender system. To improve the performance of the recommender system by targeting certain user preferences to predict accurate results.

The author Zhang et al. [11], identifies that the collaborating filtering is suffering from sparsity issues as the number of products selling rapidly increases sparsity and rebuilding the bipartite graph to improve the accuracy and density of the network in the graph than the original one. Further, the author proposed clustering algorithms to handle the performance and accuracy. In Men et al. [12], approaches are introduced to check sparsity under different scenarios and compare those approaches at different levels to enhance input. The long short-term memory algorithm is introduced to analyze the performance time under the same circumstances. Those items which are preferable to sparse values are eliminated from the recommender system to get more accurate recommendations. In Sharifi et al. [13], the author proposed a new algorithm to handle the sparsity issue by using non-negative matrix factorization to predict better results as compared to real data. a method is proposed to modify the collaborative based recommender system with the help of matrix factorization. This method proposed the incorporation Based recommender system to improve the issue of sparsity.

As rating data is not appropriate, using such an algorithm improves the prediction and provides accurate values to each. This will improve the best accuracy and recommendations.

3 Data Sparsity Resolution Algorithm in Recommender Systems and Their Analysis and Findings

In this section, we will compare algorithms which are used in the resolution of data sparsity. Discuss the algorithms used by different paper and then compare their results based on Root Mean Square Error (RMSE) and Mean Absolute Error (MAE). This will help to overcome the sparsity issues in future research work and Figure out among all of the algorithms used by different papers which gave results. All algorithms and their results are discussing Table 1.

A sample of research is completed on the sparsity issue, to reduce the issue researchers propose so many learning algorithms such as SVD, k-means, ANN. Still, our research is not completing each and every paper of sparsity in the recommender system. Above table demonstrate the analysis of the algorithms to overcome the sparsity issue. With the help of this techniques 80% of sparsity issues are removed but there is still 20% sparse data which can potentially affect the recommendation process. Based on the evaluation of different studies, appropriate comparisons have been made between various algorithms. Each algorithm has been explained with their results but it has been observed that singular value decomposition plus plus (SVD++) results provide best accuracy among all the techniques. This approach gives less error in terms of Root Mean Square Error (RMSE)—0.92 and Mean Absolute Error (MAE) is 0.72 [13].

Table 1 Comparison of algorithms

Author	Algorithms	Description	Results
Anwar and Uma [1]	Singular value decomposition plus plus (SVD++)	Comparing proposed algorithm with some machine learning approaches name as SVD and KNN	Provide less root mean square error (0.92) and mean absolute error (0.721) will improve the sparsity issue and cold-start issue
Gong et al. [14]	Memory-based collaborative filtering and model-based collaborative filtering	Comparing these two algorithm on basis of rating of items which include sparsity and scalability issues	The performance of the real time collaborative based recommender system is better than mean absolute error collaborative filtering
Koohi and Kiani [15]	Fuzzy c-means clustering algorithm is used	Comparing fuzzy c-mean clustering with K-mean and SOM clustering to get better accuracy and precision	By using fuzzy c-mean clustering improving the accuracy of the recommender system
Koohi and Kiani [16]	Proposed map reducing and clustering approach	Proposed approaches are implemented on different datasets	Such techniques are helpful to check the accuracy of recommendation based on different data set
Xie et al. [17]	N/A	The paper has conducted a systematic literature review to investigate, assess, evaluate, and discuss contributions pertaining to concepts and potential tools to eliminate data sparsity	The author emphasized on the importance of sparsity in recommender systems to propose solutions for enhancing overall efficacy and accuracy of the system
Kolahkaj et al. [18]	Dynamic contextual modeling approach	Use of density-based clustering algorithms to discover key area-of-interest to alleviate sparsity problem	Proposed mechanism outperforms previous works on metrics of precision, recall, and F-score
Althbiti et al. [7]	Proposed hybrid filtering model with ANN and Clustering algorithms	Use the k-fold and cross validation to improve the overfitting	Improve the precision, recall, ROC and F-score while adding the value in ANN

(continued)

Table 1 (continued)

Author	Algorithms	Description	Results
Zhang et al. [11]	Collaborative filtering with social behavior of users	Use of social data pertaining to different users to deal with data sparsity	The proposed method employs computational model to make predictions by calculation of sum of rating and assessment of rating patterns
Sharifi et al. [13]	Algorithm proposed non negative matrix and SVD	This algorithm is used to predict the sparse rating value and check their accuracy	Compare the non-negative matrix with SVD to get better results
Sahu and Dwivedi [19]	User profile as bridge in cross-domain recommender systems (UP-CDRSs)	UP-CDRSs transfers knowledge between various domains with the help of user profiles. In addition, probabilistic graphical model has been used to maximize posterior probability	The results tend to demonstrated that proposed method outperformed others with and without learning methods to a great extent in terms of accuracy

4 Conclusion

To summary, this paper has focused on conducting a thorough and rigorous analysis and evaluation of multivariate research papers. The primary objective of this paper has been to understand the potential trends pertaining to sparsity-related investigations and gain a strong understanding of key solutions that have been proposed by different authors. This work is an output of a broad search strategy which has been executed on a complete range of platforms to gather succinct information for performing the necessary analysis and evaluation. The study has heavily focused on understanding different algorithms proposed by a wide range of authors. In future research the algorithms can be deployed to make comparison between algorithm in case of data sparsity issue, So, that data sparsity issue get resolved. For further research, a more practical approach can be employed to gain a strong and in-depth understanding regarding the working of various algorithms to propose effective solutions.

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Recent Trends for Practicing Machine Learning in Brain Tumors: A Survey

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Abstract Brain tumors are considered to be a fatal disease that affects all age groups around the world. Abnormal formation of cells inside the brain results in brain tumors that may affect the normal functioning of the brain and hence requires urgent clinical attention. The early diagnosis of tumors may help in better clinical management and hence improve the survival rate of patients. Diagnosis reports based on biopsy procedu res are considered to be valid reports as per World Health Organization. But there were several studies reported in the literature that biopsy-based reports may contain errors which may be due to sampling or inter and inter-observer variability. Machine and deep learning-based MR methods in diagnosing brain tumors are researched nowadays as an alternative promising approach. This paper presents a survey based on machine and deep learning-based methods which tries to solve the problems of brain tumor diagnosis and classification. The paper also presents a comparative analysis of some of the approaches discussed in the literature. It was well established by the presented paper that although various machine and deep learning approaches were developed for diagnosing brain tumors, still need to be validated on global multicentric databases.

Keywords A brain tumor · Glioma · Primary brain tumor · Secondary brain tumor · Machine learning · Deep learning

1   Introduction

The brain is considered to be one of the complex organs of the human body. A brain tumor can form in two different ways: primary brain tumor and secondary brain tumor. When abnormal cell formation starts within the brain itself and if such

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abnormal formation of cells results in a brain tumor, then such type of occurrence of tumor falls in the category of primary brain tumor. When tumor cells come from the other parts of the body and form abnormal cells within the brain, such type of occurrence results in the formation of a secondary brain tumor. The brain tumor as per their malignancy, are categorized into four WHO-recommended grades: Grade-I, Grade-II, Grade-III and Grade IV. Grade I and Grade II tumors are less malignant or benign tumors and Grade III and grade IV tumors are malignant in nature. Benign tumor cases have a better survival rate as compared to the malignant tumor. Glioma is considered to be one of the most commonly occurring primary brain tumors. Glioma occurs in glial cells. Glial cells are those cells that support the nerve cells. The abnormal formation of cells within the brain affects the functioning of the brain.

Early precise diagnosis of a tumor (brain) may affect the survival of a patient [1–12]. Once the type of brain tumor is diagnosed, the clinician may plan treatment which may combination of surgical resection, chemotherapy, and radiotherapy (Fig. 1).

Biopsy reports are considered to be the gold standard for diagnosing tumor type and its grade. But several study results reported in the literature [1–8] mentioned that biopsy reports may contain errors. These errors may due to sampling, inter, and interobserver variability. The incorrect diagnosis may lead to incorrect treatment planning and hence affect the survival rate of the patient. Many clinicians and scientists are putting their efforts into developing the MR-based alternative approach
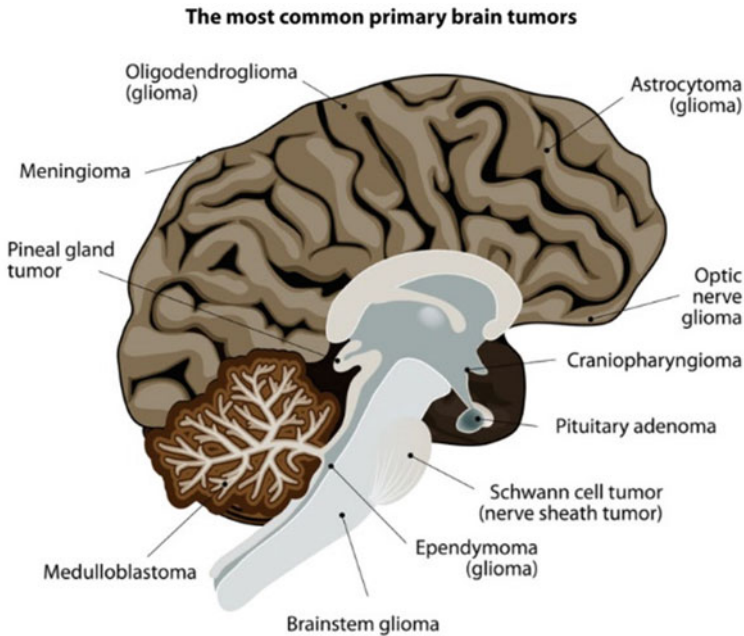
Fig. 1 Different types of brain tumors [8]

for diagnosing brain tumors. The presented paper discusses machine learning-based alternative approaches for diagnosing brain tumors.

The body of the remaining paper was structured in three major sections. Related work discusses machine learning-based approaches for diagnosing brain tumors. Comparative analysis sections give an overview of the efficiency of proposed approaches. The conclusion section finally concludes the presented paper (Fig. 2).

2 Literature Survey

In the study [1], the authors presented a survey based on machine learning techniques. As per the authors, machine learning techniques may assist radiologists and neurologists to diagnose the type of brain tumor.

In the study [2], the authors proposed the brain tumor segmentation approach using a deep convolutional neural network. To improve the proposed approach, a fuzzy-based approach had used. The reported segmentation approach was equal to 95%.

In the study [3], the authors proposed the machine learning-based concept in order to solve pediatric brain tumors. The authors developed a classifier based on 49 participants which distinguishes three pediatric brain tumors i.e., medulloblastoma, pilocytic astrocytoma, and ependymoma. Five machine learning algorithms: single layer NN, AdaBoost, RF, SVM, and KNN were tried out. Authors also used SMOTE approach to oversample their sample size.

In the study [4], the authors proposed the machine learning-based approach which tries to detect brain tumors from MR images. For conducting their study BraTS 2012 database was used. For validating their model LOOCV (Leave-one-out cross-validation) approach was used. Input MR images were denoised. Texton maps were generated followed by superpixel segmentation. The feature was extracted from this segmented portion followed by class balancing.

In the study [5], the authors proposed the SR-FCM-CNN-based approach for brain tumor segmentation and detection. For performing segmentation Fuzzy C-means and superpixel resolution were used. For performing detection CNN along with extreme learning machine algorithms.

In the study [6], the authors proposed the potential field clustering-based approach for brain tumor detection. Input MR images: fluid-attenuated inversion recovery and T2 were denoised with help of the Weiner filter. Once input images were denoised, with the help of the Potential Field based clustering approach along with global threshold and morphological operations, tumor pixels were located. For accurate classification, Local Binary Pattern (LBP) and Gabor Wavelet Transform features were used.

In the study [7], the authors proposed the RF-based method for brain tumor segmentation. Two MR imaging sequences i.e., T1CE (Contrast Enhanced) and FLAIR images were used in the carried-out study. The authors trained their machine learning-based model using the BraTS 2013 dataset. For validating their developed

a: New Case
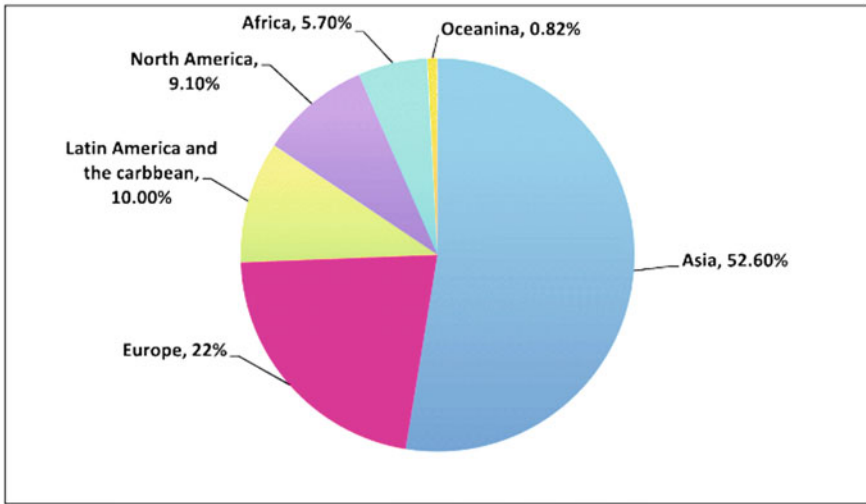
b: Death
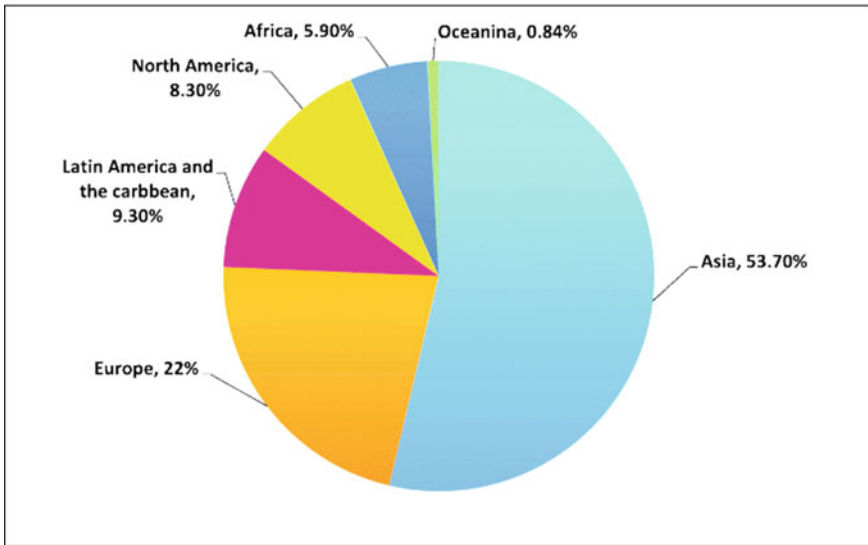
Fig. 2 As per information mentioned in the Cancer Registry (2018), there are 296,851 registered cases related to brain cancers. The highest incidence of new brain cancer and death was reported in Asia (156,217 cases, 52.6%) and 53.70% respectively

model BraTS 2017 dataset was used. From the input MR images, 275 features map were extracted. Using these feature maps, RF calculated the probability. Once these steps were carried out successfully, voxel-wise clustering algorithms were used in order to segment the tumor. In a study [9], the authors presented a survey study based on DL-based methods for segmentation and classification.

In the study [11], the authors presented CNN based approach for segmentation and classification. Authors combine the deep learning plus data mining approach for classifying the brain tumor task. In the study [12], the authors developed software using deep learning-based approaches for the detection of brain tumors using T1 weighted magnetic resonance imaging. The proposed software had capabilities to classify MR images into three types of brain tumors i.e., Gliomas, Meningioma, and Pituitary tumors.

In the study [13], the author developed SVM based model to classify tissue into hard and soft tissue. Input images were converted into grayscale images followed by morphological scanning. Segmentation and feature extraction was performed afterward. These extracted features were fed into an SVM classifier for classification into soft and hard tissue. In Study [14], the authors proposed an approach for detecting brain tumors. On input MR images genetic algorithm was applied. With the help of the curve fitting approach, features were extracted. These extracted features were fed into SVM for brain tumor detection. In the study [15], the authors proposed an improvement in survival prediction of brain tumor patients. The BraTS dataset was used to carry out this study. Before developing the prediction model, the input images were denoised with the help of denoising wavelet transform (DWT).

In the study [16], the authors proposed the approaches based on PSO (Particle Swarm Optimization) and support vector machine. Input MR images were denoised with the help of wavelet features. Segmentation of region of interest (ROI) followed by feature extraction from this segmented ROI was performed. With the help of the PSO approach, feature selections were performed. Once the features were selected, SVM was used to classify the images into benign and malignant tumor types. In the study [17], the authors proposed SVM based approach for segmenting the tumor legion from FLAIR images. The study was performed using the 2018 BraTS dataset. In the study [18], the authors performed the classification task i.e., distinguishing pilocytic astrocytoma from the high-grade tumor. SVM concept was used to carry out the classification task.

3 Comparative Analysis

References	Techniques	Problem approached	Performance
[2]	Deep convolutional neural network + fuzzy based	Segmentation	Accuracy = 95%

(continued)

References	Techniques	Problem approached	Performance
[3]	Single layer neural network + AdaBoost, RF, SVM, KNN	Classification of pediatric tumors: medulloblastoma, Pilocytic astrocytoma, ependymoma	Accuracy = 85%
[4]	RF	Brain tumor detection	Dice = 88%
[5]	SR-FCM-CNN	Brain tumor segmentation	Accuracy = 98.33%
[6]	Potential field clustering	Brain tumor segmentation + detection	PSNR = 76.38 MSE = 0.037 SSIM = 0.98
[7]	RF + voxel-wise clustering algorithm	Brain tumor segmentation	Median dice score for LGG = 40.9% Median dice score for HGG = 75%
[11]	DL + DM	Brain tumor segmentation + classification	Accuracy = 91%
[12]	DL	Classification: gliomas, meningioma and pituitary tumor	Accuracy: Gliomas = 99.77 Meningioma = 99.81 Pituitary = 99.65
[13]	SVM	Classification: soft and hard tissue	Accuracy ≈ 80%
[14]	SVM + curve fitting + genetic algorithms	Brain tumor detection	Accuracy = 82.59%
[15]	Denoising wavelet transform	Survival prediction	Accuracy = 66.71%
[16]	PSO + SVM	Classification: benign, malignant	Accuracy = 95.23%
[17]	SVM	Segmentation	Dice ≈ 90%
[18]	SVM	Classification: PA versus HGG	Accuracy = 90%

* *Abbreviations* DCNNA: Deep Convolutional Neural Network; SVM: Support Vector Machine; KNN: K Nearest Neighbour, RF: Random Forest, SR: Super Resolution; FCM: Fuzzy C-means; CNN: Convolutional Neural Network; PSNR: Peak Signal to Noise Ratio; MSE: Mean Square Error; SSIM: Structure Similarity Index; LGG: Low-Grade Glioma; HGG: High-Grade Glioma; DL: Deep Learning, ML: Machine Learn-ing, DM: Data Mining, PA: Pilocytic Astrocytoma, HGG: High-Grade Tumor

4 Conclusion

The brain tumor is considered to be a life-threatening disease. MR-based machine learning approaches are researched nowadays to detect tumors, their type, and their grade. The presented paper focuses on this domain. The presented paper is composed

of three major sections i.e., introduction, related work, and comparative analysis. The introduction section establishes the need for machine learning techniques in brain tumor detection and its classification. The related work section discusses the work done in the domain of brain tumor detection and classification. The objective of this section was to give its readers a short description of proposed approaches in the literature. A table was also presented in the comparative analysis section. The table summarizes the performance evaluation of various proposed approaches available in the literature and is discussed in the related work section of this presented paper. The conclusion section finally concludes the paper. One major finding of the presented paper was that although machine learning-based approaches show promising results in brain tumor-related diagnosis it needs to be validated on the global multicenter dataset.

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Voice-Based Intelligent Virtual Assistant

Ragini Goyal and Jyoti

Abstract The Virtual Personal Assistant (VPA) is one of artificial intelligence's greatest breakthroughs, giving people a new method to conduct their work with the help of a machine. This article gives a quick rundown of the approaches and concepts used to construct a Virtual Personal Assistant (VPA) and then use it in a variety of software applications. Speech Recognition Systems, also known as Automatic Speech Recognition (ASR), play a crucial part in virtual assistants, allowing users to converse with the system. We want to make a "WAANI" which is a virtual personal assistant in this project, and it will have vital characteristics that will help you satisfy your demands. We'll make it as entertaining as possible, much like previous VPAs, with user experience in mind. Several Natural Language Understanding (NLU) technologies, like International Business Machines (IBM) Watson and Google Dialog Flow, were created with this goal in mind. For the implementation of the software application in our project, we selected Google Dialog Flow as the NLU platform. The application's user interface is built on the Flutter software platform. All of the models utilised in this VPA will be built to be as energy efficient as feasible. Some of the common characteristics seen in most VPAs will be included. WAANI will be implemented via a smartphone app, with the intention of implementing it in the desktop environment in the future. The approaches utilised in the development of apps are assured to be provided in the following paper. Provides the outcomes of the developed functions inside of the application. It demonstrates how to utilise existing natural language understanding platforms to decrease user demand and then create a reliable software application.

Keywords Artificial intelligence · Natural language understanding · IBM Watson · Google dialog flow · Speech recognition

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1 Introduction

Artificial intelligence and machine learning have made our live simpler in this new era of technology and innovation, and one of the most crucial is communication [1]. The concept of having a conversation with a machine has appeared futuristic since IBM unveiled the first digital voice recognition tool, the IBM Shoebox, in the 1960s. A smart virtual assistant is a digital life aid designed to make the user's life easier. It is a highly developed programme with a robust voice recognition engine that focuses on processing an audio input, turning it to text, and completing the task [2]. The majority of virtual assistants use speech as their primary mode of contact [3]. It focuses on processing the system's auditory signal, turning it to text, and completing the task. In general, speech processing consists of the following components: a Speech to Text module that converts speech signals into text, a parser that extracts the semantic context, a dialogue handler that uses machine learning algorithms to determine the system's response, a response generator that provides the system response as text, and a speech synthesiser that converts the text into a speech signal [4]. When created by a regular user, numerous issues may arise, such as recognition accuracy, robustness in conducting operations, and so on. and may not always be able to solve the problems. As a result, we've attempted to present an outline in this post that will aid the user in comprehending the techniques and stages involved in creating a virtual personal assistant. We looked at diverse approaches, outcomes, and constraints that have been published by different scholars [1, 5, 6].

2 IBM Watson Versus Google Dialog Flow

2.1 *IBM Watson*

Advantages and Drawbacks IBM Watson, among other artificial intelligence (AI) systems, tops the market in terms of software rankings. For businesses searching for a dependable computer software, IBM Watson appears to be a superior option. Focuses on client behaviour; with the support of data repositories and analytics, we may have access to more data that will aid future consumer encounters and intercepts. Machine Learning Algorithms, Speech to Text and Text to Speech Modules, Artificial Intelligence Services (AI), Cloud Functions (to be written in jQuery) for connection with the User Interface (UI), Webhooks to connect to the web, and other IBM Discovery Services are available to users on the IBM Cloud. These Watson Helper related services enable users to create their own customised interactive assistant. Chatbots created using IBM Watson give customers the impression that they are speaking with a live customer service professional on the other end of the line. Consider the behaviour of customers and employees to the benefit of the company. Apart from delivering a variety of sophisticated features for application development, IBM Watson does not have a language function other than English. As a result, it

can only be used in a few areas throughout the world. The software is also difficult to maintain and cannot process structured data, market and organizations limits of affording to purchase their strategies.

2.2 Google Dialog Flow

Advantages and drawbacks Dialog flow's key benefit is its Google integration. The machine learning algorithms built into the platform help to understand the natural language which is the expression of the user using agents. Each agent has intent that matches the user's statement, and action is taken in answer to questions. It allows agents to engage brief discussions with users in addition to providing answers to consumers. Developers may also utilise the platform's premade templates as a starting point for their projects.

2.3 Feature Comparison Between IBM Watson and Google Dialog Flow

Machine Learning: Users of IBM Watson and Google Dialog flow can utilise this feature to calculate data. It comprises the Natural Language Processing(NLP) and Natural Language Understanding (NLU) algorithms required for the system to interpret the natural language of the user's expression. The NLP module receives the text input and converts it into structured data. Other Speech to Text algorithms given by platforms is used to handle speech input for further processing.

Chatbot: Platforms guarantee that users may communicate with the system using chatbots. All user generated queries are addressed here. These chatbots are meant to communicate with users in the same way that humans do, delivering a natural experience for those who use them.

Handling Structured Data: Because it uses the natural language processing module to turn user expression into structured data, Google Dialog flow can handle structured data. However, IBM Watson is unable to handle structured data directly, restricting its usage in many enterprises.

Services: Watson Discovery Services, Watson Studio, Speech to Text and Text to Speech Services, Machine Learning(ML) and Artificial Language Modules, Deep Learning, Language Classifier, and many other IBM services meet the requirement for data processing and calculation. Google Dialog flow offers two editions: Dialog flow Essentials (ES) Edition and Dialog Flow Customer Experience(CX) Edition, both of which may manage and assist in the development of an application system. Various NLP, ML, and AI models, such as those used by IBM, assess data for further processing and take the necessary actions.

Overall integration and performance: When it come to integration, IBM Watson takes a long time and effort to integrate its services with the company, leading the project to be delayed. IBM's services are still constrained to suit its demands as the amount of data grows. Because IBM software is more expensive than any other software platform on the market, Watson is only available to enterprises who can afford it. Dialog flow ES and Dialog flow CX are the two variants of Google Dialog flow available to users. Because ES is a standard version, it offers the option of integrating the application with the dialogue flow via the Fulfilment Feature or the Service Application Programming Interface (API), depending on the user's preference. As a result, Dialog flow has never had a problem with integration. In Dialog flow, the ES model is free, whereas the CX model has a price that changes dependent on quotations and user requests. Google Dialog flow claims to be able to manage massive volumes of data and provide services for ES and CX models [7]. The Dialog flow platform also has a feature of 14+ languages, which IBM Watson does not have because it only has an English function on its platform, restricting the use of performing software to several parts of the world's countries. So, both IBM Watson and Google Dialog flow have their fair share of strengths and weaknesses. Considering the factors and requirements of a particular project, you should choose one of the software platforms plans which allow you to choose the most suitable software platform for your system application.

3   Methodology

3.1   User Interface

Flutter is an open-source software development technology that was utilised to create the app's appealing user interface. The platform's many packages and graphics library enable quicker application operations, regardless of the operating platform to the application interface. It makes it simple for developers to construct cross platform applications. This eliminates the need to create separate Android and iOS apps.

3.2   Dialog Manager

The Dialog Manager application is developed as part of the backend. The ES (Standard) version of Google Dialog flow, which manages all conversations and actions communicated by users, was utilised to construct a natural language understanding platform for the application. The following functionalities are available:

Dialog flow Agent: It is in charge of handling the user's chats and translating the user's voice command into text or text command into comprehensible structured data for the application. Each agent is composed of intentions as well as entities [8].

Fig. 1 Classification of intent

Intents: It is responsible for matching the user expressions collected in the preceding phase with the agent's best intention. The intent categorization is another name for this intended match. An example of Agent Weather with an intended prediction is shown in Fig. 1.

The following are the components of a basic intent:

1. Phrases for Training: 1087 These are some examples of what customers could say.
2. Action: When an intent is activated, do particular actions for it.
3. Parameters: Dialog flow offers the values derived from the end-user expression as arguments when an intent is matched at runtime. Each parameter has an Entity Type, which controls how the data is accessed in detail.
4. Response: Provides replies to the user's questions.

Entities: Dialog flow provides default system entities to match dates, hours, and email addresses, among other things. The user can also define entities based on the type of data that the system application manages [6].

User interactions with the API: You must develop direct interaction code to interface with the Dialog flow API service. The processing sequence while communicating with the API service is depicted in Fig. 2 [4].
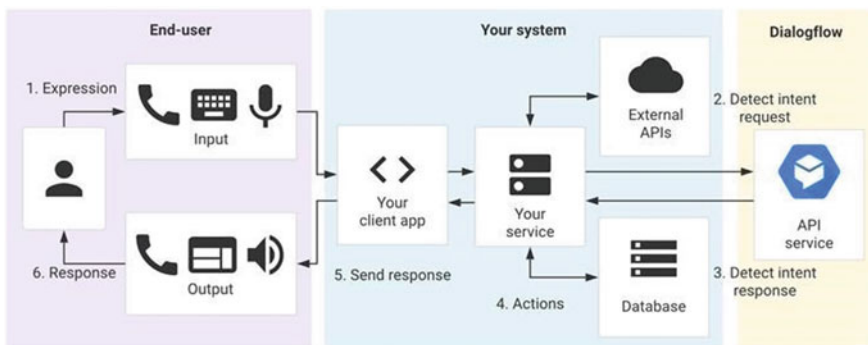
Fig. 2 Communication with API

Dialog flow Console: The Dialog Flow Console is a web-based user interface for creating, testing, and modifying agents. Agents for sophisticated situations may be built with the aid of dialogue flow APIs.

3.3 Block Diagram of Dialog Flow with Machine Learning

The flowchart of Dialog Flow is depicted in Fig. 3.

4 Implementation

Our key objective after completing the user interface was to create a dialogue manager that could handle all user requests, including voice and text, and complete the work. Google Dialog flow was needed for the same, being an NLU platform. The Dialog flow console is shown in Fig. 4.

User expressions were matched using the intents and entities of each Dialog agent, and the process of replying to them was completed. The different intents and entities contained in our application are depicted in Figs. 5 and 6.

Next, we evaluated the entire dialogue manager using the Google Dialog flow test tool to see if conversations were handled correctly. This is seen in Fig. 7.
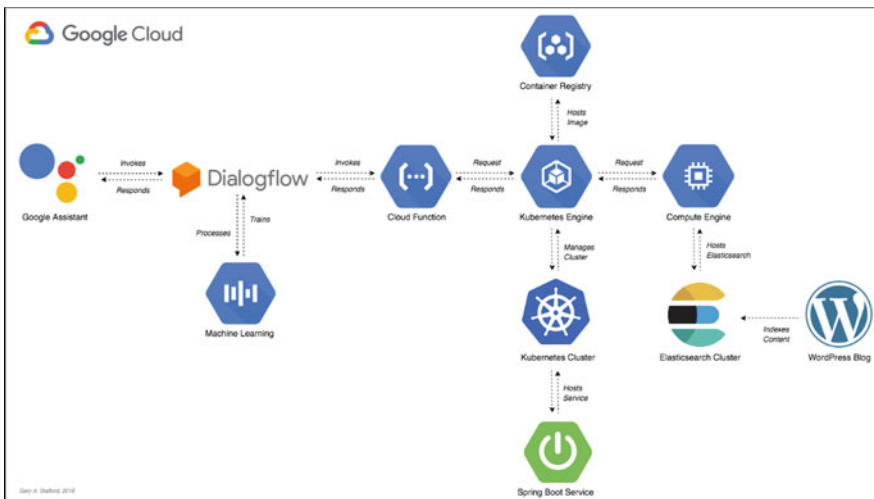
Fig. 3 Block diagram of dialog flow
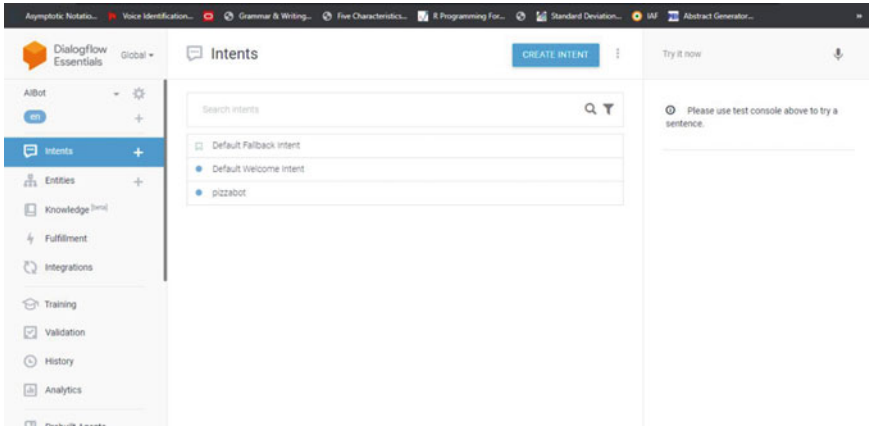
Fig. 4 Dialog flow console by google
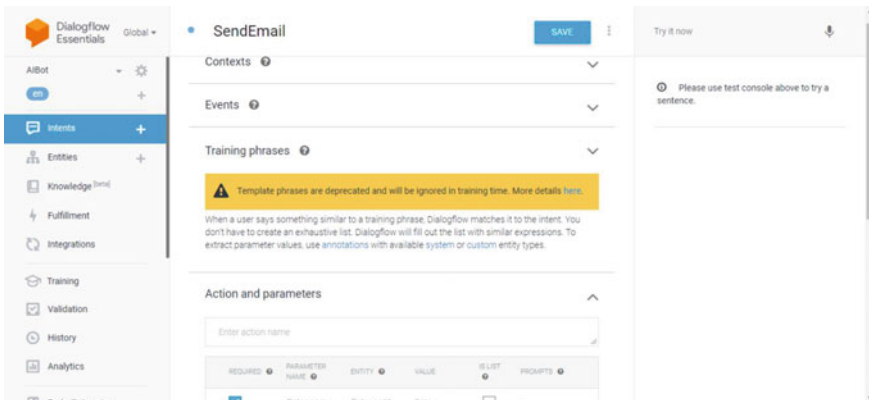
Fig. 5 Entities and intentions

4.1 Speech Recognition

Depending on the user's preference, the application's input might be in text or speech. The text commands were taught and tested automatically using Natural Language Platform integrated with Google Dialog flow. Dialog flow was in charge of the application's natural language processing (NLP). In terms of speech instructions, Dialog flow has a built-in SpeechToText API that contained several Machine Learning and Neural Network techniques for text extraction from speech even in noisy circumstances. As a result, WAANI included speech recognition as an extra function, making it more appropriate for users with severe workloads.
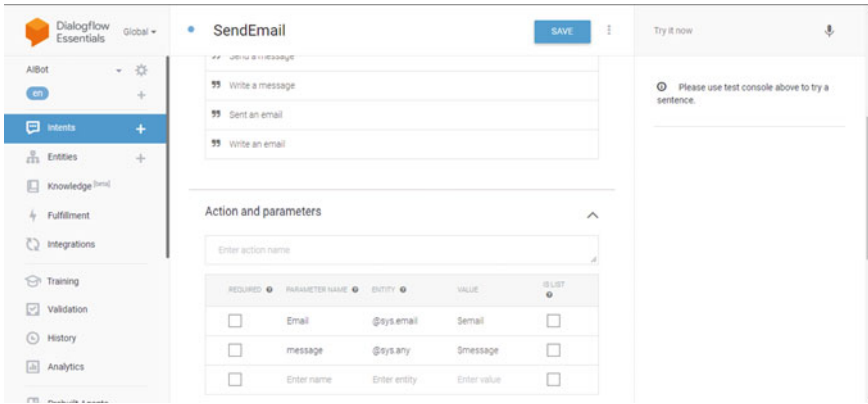
Fig. 6 Intents and entities
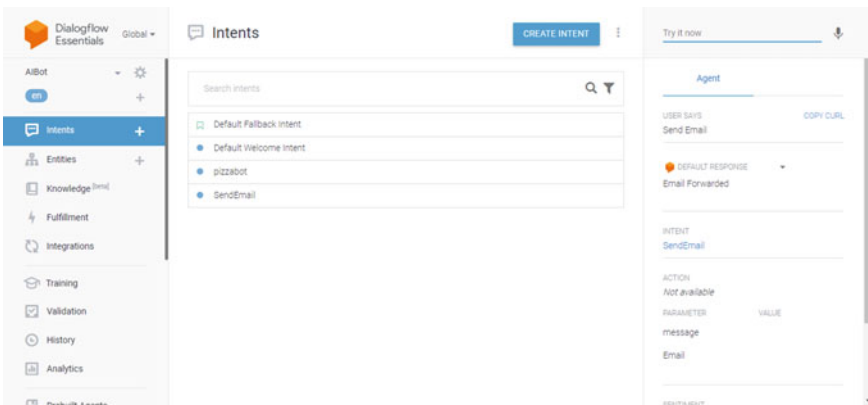
Fig. 7 Testing

4.2 Other Features Include

The open app interaction functionality required user permission to utilise, which was taken care of by Flutter's "permission handler" plugin. This plugin provides a cross-platform API for other apps on the device to seek and control permissions. As a result, WAANI was able to handle these user requests.

4.3 Detection of Objects Feature

The Convolutional Neural Network (CNN) model was used only for object detection, which might assist recognise objects with better confidence levels. To acquire
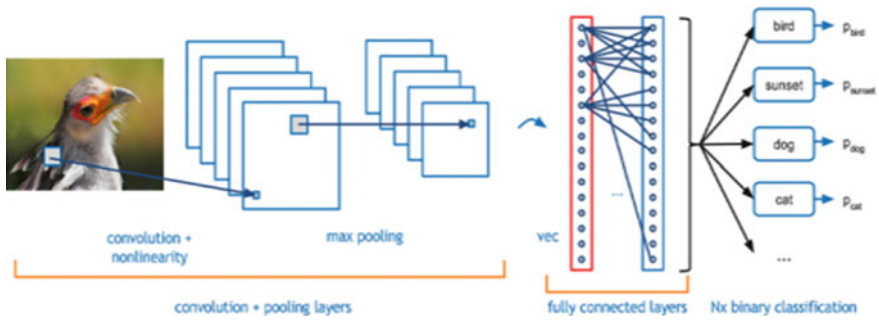
Fig. 8 CNN assists with object detection

accurate results, the model was trained with several photos and its mesh was quite thick. Figure 8 illustrates how CNN aids in object detection. It incorporates the convolutional layer and the Max clustering layer, among other network layers. Each layer extracts the majority of the image's identifiable characteristics and turns it to a vector. In these vectors, a completely linked layer is extended. As a result, the picture is identified using the training set. This is a neural network consisting of deep layers inside is therefore capable of detecting images when applying the test set [1].

5   Results

5.1   Sign Up and Login Page

The login page allows users to log in to the programme by entering their user credentials, which include their e-mail address and password. The signup page is for users who do not want their information saved in the app. With the aid of Google Dialog flow, the needed information is retrieved from the user and saved in the Google database. The photos in the next section depict the WAANI application's user interface. View the Login Page as well as the Registration Form as depicted in Figs. 9 and 10.

5.2   WAANI's Launch Page

The programme activates the start page after the login page, as illustrated in Fig. 11.

Fig. 9 Page for
registration/login

5.3 Opening of Various Applications Through WAANI

WAANI is effectively capable of opening the Applications mounted with inside the
Device because with the use of the Flutter Software Platform, the application is given
authorization to fully obtain entrance all of the apps.

5.4 Object Detection Feature

The characteristic of Object Detection with inside the Application is an introduced
characteristic aside from acting the basic responsibilities like getting access to
different applications. It allows the consumer to apply for the purpose of Object
Detection, the device camera or images in the tool's Gallery are used. The charac-
teristic displays the amount of confidence for each label it applies to. As a result, the
customer is more likely to be aware of the object's particular identity as depicted in
Fig. 12.

As a result, WAANI is capable of performing the functions of a virtual personal
assistant. It performs all the tasks of a virtual personal assistant.

Fig. 10 Page for registering
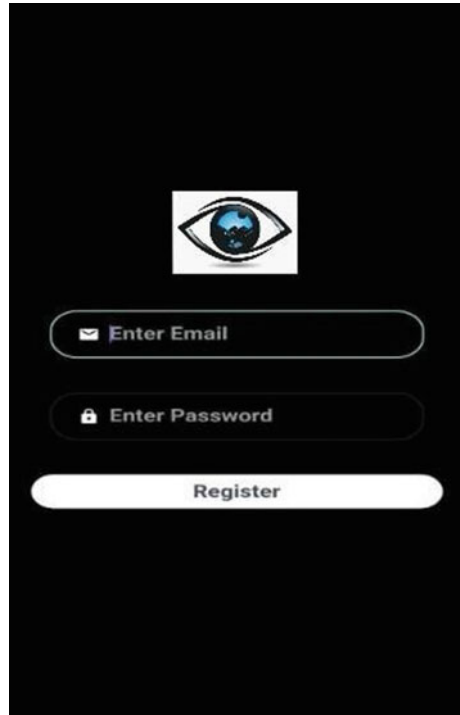
6 Conclusion

The suggested research will provide information on the most common approaches that may be utilised to develop their own Virtual Personal Assistant. The survey presented in this article will aid in obtaining clear information on the differences between IBM Watson and Google Dialog Flow, which are both Natural Language Understanding Platforms. This will aid in determining which of them is the best fit for future projects. The study also included research on a variety of projects that were carried out using Google Dialog Flow and IBM Watson, with the goal of determining their roles. In our project, the app WAANI grew with the help of Google Dialog Flow to be capable of carrying out concepts for accessing other apps installed on the smartphone, such as social networking apps like WhatsApp and Instagram, and Gmail. Its user-friendly platform, which was created with the help of Flutter, made it simple to access the application. With the help of Flutter's Graphic apps, we had been capable of offering an appealing user interface. It changed into capable of carrying out the primary functions is expected of a perfect Personal Assistant. The voice recognition feature allowed customers to carry out side by side to the utility the duties through giving Voice Commands. The Application changed into additionally able to manage small communication with the user. With the improvement of the Application, We were able to gain adequate knowledge in Natural Language

Fig. 11 The WAANI's
official website
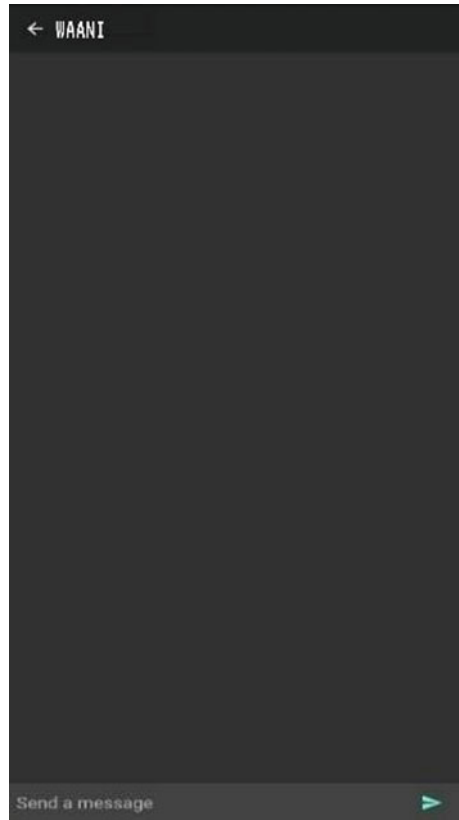
Understanding Platforms and Machine Learning Models, which will serve as the
foundation for future Artificial Intelligence Model development.

7 Future Scope

The suggested method might be employed in the future by developing a software
programme that could be used in a variety of sectors of society, such as health care,
educational institutions, and so on. Many externally available services for customers
might be combined into a single app utilising Google Dialog Flow and other NLU
platforms on the market, making application software multipurpose. We want to
inspire readers to learn more about natural language platforms and how to utilise
them to create apps that will fulfil the needs of a varied world.

Fig. 12 Object detection
feature
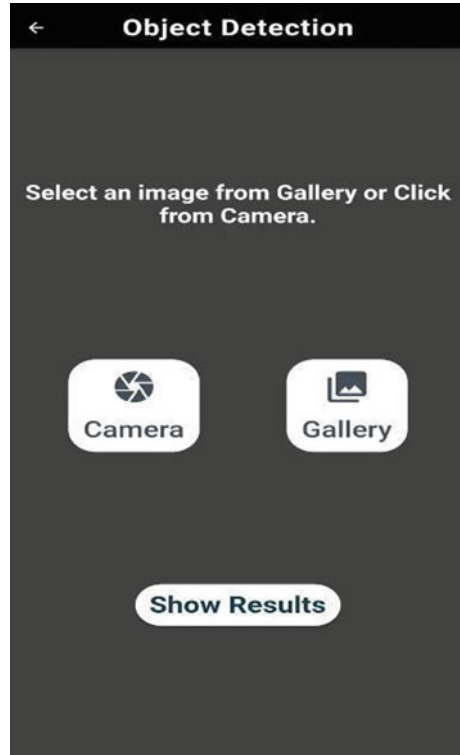
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Identification of Autism Spectrum Disorder from Functional MRI Using Deep Learning

R. Pavithra, S. P. Abirami, S. Krithika, S. Sabitha, and P. Tharanidharan

Abstract Autism spectrum disorder (ASD) is a collection of a way of continuing neurodevelopment illnesses identified by limited and repetitive behavioral patterns, as well as social and communication impairments. Despite the fact that symptoms are most common in childhood, diagnosis is sometimes delayed. Because the current ASD diagnostic technique is solely uncertain and questionnaire, requiring the physician to review the behavior and developmental history of a child. It's been suggested that behavioral symptoms in ASD are linked to brain findings of increased short-distance and diminished long-distance connections. The suggested approach makes use of brain imaging data from Autism Brain Imaging Data Exchange (ABIDE), a global multi-site database. For ASD identification, the proposed approach uses functional connectivity characteristics extracted from resting state functional MRI data. ASD patients' brain connections could be disturbed. The presented method extracts time series from 122 regions of interest defined by the Bootstrap Analysis of Stable Clusters (BASC) and also extracts time series from 48 regions of interest defined by the Harvard Oxford (HO) brain atlas to create an efficient functional connectivity matrix for all individuals. Synthetic Minority Over-sampling Technique (SMOTE) an oversampling procedure employed for artificial data generation. The classification challenge is carried out using a Recurrent Convolutional Neural Network (RCNN) and Convolutional Neural Network (CNN) and results were compared. In both models, fivefold Cross-Validation is applied. The model performed better in the modified experiment, with RCNN achieving an accuracy of nearly 85%.

Keywords ASD · Resting state fMRI · Recurrent convolutional neural network · ABIDE · Functional connectivity

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1   Introduction

Autism, usually referred as Autistic Spectrum Disorder, is a complicated neurological disorder marked by qualitative behavioral and cognitive impairments. It usually shows in the first three years of life and has an impact on social connection and cognitive skills development. Autism could be caused by both genetic and environmental factors. It is linked to a variety of behavioral signs, some of which might become dangerous if the diagnosis is ignored. The proposed system's main objective is to use deep learning to identify autism spectrum disorder from resting state functional magnetic resonance brain images. The brain images recorded in the resting state functional MRI represents the variation in intensity of signal termed as Blood Oxygen Level Dependent (BOLD). The proposed system involves collecting preprocessed fMRI, time series extraction from regions of interest (ROI), building functional connectivity matrices, data partitioning using k fold cross validation and classification using deep learning methods such as CNN and RCNN. The brain atlas was utilized to specify specific brain areas of interest rather than dealing directly with the entire time series obtained from each brain voxel. To extract time series from ROIs, the proposed technique employs two distinct brain atlases: Bootstrap Analysis of Stable Clusters (BASC) and Harvard Oxford (HO).

2   State of Art

Many theories have been presented in relation to the utilization of machine learning algorithms for autism spectrum disorder diagnosis. This literature review concentrates on and covers a wide range of similar studies.

Eslami et al. [1] proposed a system called auto-ASD network to detect autism spectrum disorder using functional mri from ABIDE dataset. The fmri is preprocessed using CPAC pipeline, brain parcellation is done using spatially constrained spectral clustering algorithm and data is augmented using synthetic minority over sampling technique. MLP is used for classification or feature extraction. SVM is the final classifier, and Auto Tune Model is used to discover the best parameters for it. The accuracy of this system is 80%.

Haweel et al. [2] proposed a system for evaluating autism spectrum disorder extremity levels using assignment based fMRI from Biomarkers of Autism at 12 months: From Brain Overgrowth to Genes dataset. The fMRI is preprocessed using FSL and brain areas mean and standard deviation are calculated using a general linear model. Brain atlas named Brainnetome atlas is used to extract features and Recursive feature elimination is used for feature selection. They have implemented three machine learning algorithms with an accuracy of SVM-57%, MLP-71% and RF-78%.

Huang et al. [3] proposed classification model based on graph using deep belief networks to detect autism spectrum disorder using resting state fmri from ABIDE

dataset. It involves preprocessing data, selecting the features through graph extension of KNN and refined it by a confined path based DFS algorithm. Data augmentation techniques are used to name the variants within ASD. RF, SVM and CNN were used for performance comparison and deep belief networks achieved the highest accuracy of 74%. This work is also able to diagnose subtypes of ASD.

Pugazhenthi et al. [4] implemented autism spectrum disorder detection using structural mri from ABIDE dataset. In this research alexnet is used for classification and brain tissues like white matter and gray matter are segmented and categorized by intensity value. The magnetic resonance brain images were segmented using multilevel thresholding, and the images were then RGB segmented for better tissue identification. The researchers found that an increase in brain density and a large percentage of white matter are the two characteristics that can be used to diagnose autism. Alexnet has an accuracy rate of 82.61%. Similar experiments were made by various researchers involving machine learning algorithms.

As per the survey of ASD detection using machine learning methods, the application of machine learning algorithms to detect ASD is a wise decision.

3 Proposed System

The main goal of the proposed methodology is to identify the autism spectrum disorder using resting state functional MRI. The preprocessed functional MRI of ABIDE 1 dataset is collected and time series are generated from the regions of interest defined by brain atlas for each individual. This system uses two different brain atlases, BASC and HO which contain 122 and 48 regions of interest respectively. Then the functional connectivity matrix is computed for each individual and flattened to a one dimensional feature vector. This system uses Principal Component Analysis (PCA) to narrow the dimensions of the feature vector and uses SMOTE to create fictional data using available data. CNN and RCNN are used for classification along with fivefold cross validation. The models are evaluated with four different inputs, feature vector after dimensionality reduction, feature vector with artificial samples, feature vector with and without artificial samples and dimensionality reduction. Figure 1 depicts the structural outline of the proposed system for autism spectrum disorder classification.

3.1 Dataset Description

ABIDE is an union of 17 international imaging sites that provides each individual with resting state functional and structural MRI as well as phenotypic data. The phenotypic information are gender, age, ASD or normal individual and so on. ABIDE has data on 1035 people, 505 of whom have ASD and 530 of whom do not. The resting state functional MRI employed in the system was preprocessed with the CPAC pipeline, which comprised slice timing adjustment, realignment of motion, normalization of

Fig. 1 Flow diagram of the
proposed approach
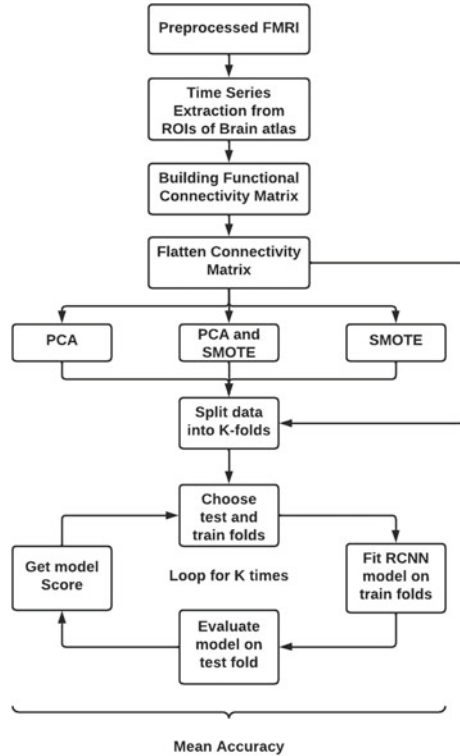
intensity, and annoyance signal reductions like breathing and heartbeat, global signal
regression, and band pass filtering.

3.2 Time Series Extraction from ROI Using Brain Atlas

A functional MRI is a series of three-dimensional images that detect BOLD signals
across a span of time. The variation in BOLD signal strength is represented by the
brain images recorded over time in resting state fMRI. The BOLD signal intensity is
used to determine which brain areas are functioning. The measure of BOLD signals
at every voxel across time is called a time series. Regions of interest (ROI) were
employed instead of obtaining the whole time series from all voxels. The brain atlas
outlines peculiar regions of interest in the brain. Two separate brain atlases, BASC
and HO, were used in the suggested system. The BASC atlas is a functional atlas,
while the HO atlas is a structural atlas. In BASC and HO, there are 122 and 48
regions of interest, respectively. Figure 2 represents the 122 ROIs of BASC atlas and
48 ROIs of HO atlas.
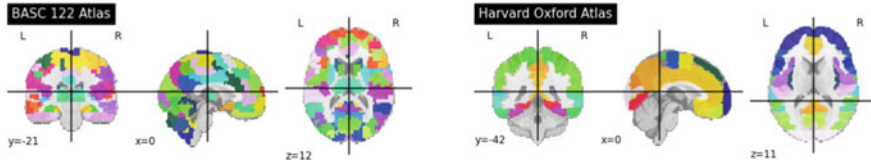
Fig. 2 ROIs of BASC atlas and HO atlas

There were 196 time points in each fMRI. The 4D data of each fMRI were transformed into 2D data with dimensions such as time point and number of ROIs. The dimensions of the extracted time series using BASC and HO atlases were (196, 122) and (196, 48) respectively.

3.3 Functional Connectivity of ROIs

Functional connectivity is used in the proposed system to classify ASD and normal individuals. A matrix of connections that quantifies the relationship allying a group of separate brain ROIs as described by the brain atlas is known as functional connectivity. The 2D time series data was then morphed into a functional connectivity matrix with dimensions (122, 122) and (48, 48) for BASC and HO brain atlases respectively. The connectivity matrix is symmetrical. The upper triangular values together with the diagonal values were removed and the lower triangular values were retained. The lower triangular part is flattened into an K-sized 1D feature vector.

$$K = \frac{n(n-1)}{2} \tag{1}$$

where n is the number of ROIs. Therefore, 7381 and 1128 were the sizes of feature vectors for BASC and HO atlases respectively.

3.4 CNN Classifier

The proposed system involves two convolutional layers succeeding by a max pooling layer. The filter is applied to our input to extract its features in the convolutional layer, and the max pooling calculates maximum value from the feature map. After convolution and pooling, the learned features are flattened and passed via a fully connected layer prior to the output layer. L2 regularization with regularization rate of 0.01 is used. Rectified Linear Unit (ReLU) activation is utilized in the hidden layer which is defined in Eq. (2)

$$f(x) = \max(0, x) \tag{2}$$

The output layer uses a sigmoid activation. Sigmoid activation function is defined in Eq. (3)

$$f(x)\frac{1}{1 + e^{-x}} \tag{3}$$

where e is the euler's number. Adam optimizer is employed with a 0.005 learning rate. The loss function utilized in this classification is binary cross entropy, which is defined in Eq. (4)

$$L = -\frac{1}{s} \sum_{i=1}^{s} \left[y_i \cdot \log(p(y_i)) + (1 - y_i)\right] \tag{4}$$

where s is the number of samples overall, y is the label and p is the probability of y referring to ASD or normal individuals.

3.5 RCNN Classifier

The Recurrent Convolutional Layer (RCL) is the most essential part of RCNN. The output of RCL units varies in discrete time steps. RCL uses Rectified Linear Unit (ReLU) as activation function. At time step t, a unit's output is a function of its net input.

$$x_{ijk}(t) = b\left(f\left(z_{ijk}(t)\right)\right) \tag{5}$$

where f is the ReLU activation function and b is the batch normalization function. The RCL is unfolded for t time steps, yielding a depth t + 1 feedforward network. The recurrent input evolves across iterations, whereas the feedforward input remains constant. Only feedforward input is present when t = 0. A heap of RCLs could be arranged in alternate layers with max pooling layers in the RCNN. The first layer of the proposed system is a feedforward convolutional layer with no recurrent connections, followed by four hidden RCLs with dropout and a max pooling layer in the midst. The RCLs each run for four time steps. Between nearby RCLs, there are only feedforward connections. The fourth RCL's output is sent to a max pooling layer, which is succeeded by a flatten layer. Finally, a sigmoid layer is employed to differentiate between ASD and typical people. It utilizes the identical optimizer and loss function as another CNN model.

4 Results and Discussion

Using resting state MRI scan images, the proposed system attempted to identify autism. The research was carried out using varied techniques and results were analyzed based on accuracy, precision and recall. Tables 1 and 2 compare the results of RCNN and CNN for the BASC atlas, where Tables 3 and 4 compare the results of RCNN and CNN for the HO atlas. To avoid overfitting, one of the data augmentation techniques called SMOTE is employed and also for feature reduction PCA is applied.

The pictorial view for accuracy comparison for BASC and HO atlas is shown in Fig. 3. From the graphs it is inferred that RCNN gives good accuracy when compared with CNN. Furthermore, when compared to the HO atlas, RCNN produces good results for BASC.

Table 1 Comparison of parametric value over RCNN implementation—BASC atlas

Parameters	Accuracy	Precision	Recall
RCNN	85.02	89.90	77.08
RCNN–PCA	80.38	79.44	82.81
RCNN–SMOTE	85.94	90.17	78.55
RCNN–PCA–SMOTE	81.41	84.75	79.71

Table 2 Comparison of Parametric value over CNN implementation—BASC atlas

Parameters	Accuracy	Precision	Recall
CNN	75.65	76.85	70.89
CNN–PCA	72.27	72.19	70.79
CNN–SMOTE	71.79	73.28	67.51
CNN–PCA–SMOTE	69.24	72.30	66.00

Table 3 Comparison of Parametric value over RCNN implementation—HO atlas

Parameters	Accuracy	Precision	Recall
RCNN	84.34	85.69	82.46
RCNN–PCA	77.00	84.18	62.09
RCNN–SMOTE	84.81	82.91	88.37
RCNN–PCA–SMOTE	81.69	84.47	76.43

Table 4 Comparison of Parametric value over CNN implementation—HO atlas

Parameters	Accuracy	Precision	Recall
CNN	72.07	70.51	74.92
CNN–PCA	74.10	73.67	73.64
CNN–SMOTE	77.64	77.47	77.94
CNN–PCA–SMOTE	73.67	73.24	74.03
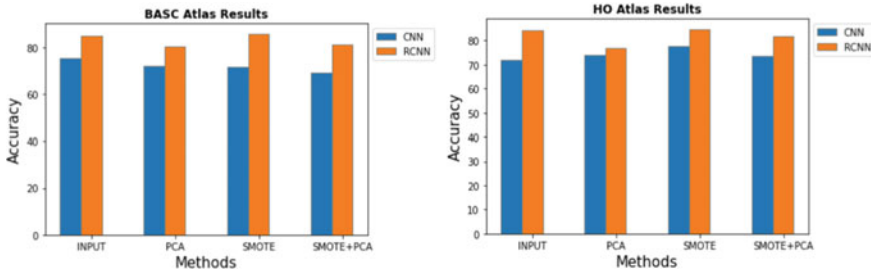
Fig. 3 Comparison of accuracy over proposed models

5 Conclusion and Future Work

The major goal of this study is to use MRI images to diagnose Autism Spectrum Disorder. CNN and RCNN are used in the proposed system. The classifier models have been implemented for two brain atlases, each of which will provide time series from different brain ROIs. The collected time series is utilized to create a matrix of functional connections, which is then transferred into a one dimensional vector. Data augmentation approach called Synthetic minority over sampling technique is used to create synthetic data, which is then supplied to principal component analysis to reduce dimensionality and speed up training. The pca output is then fed to the classifiers for accuracy and correctness checks. This reduces the amount of work required to train models with limited features. When comparing the results of CNN with RCNN, RCNN outperforms CNN in terms of accuracy. For future work, to improve the accuracy of the prediction, the system can use several brain atlases to extract time series and also create a model that can assess the severity of ASD.

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Conversion of Sign Language to Text and Audio Using Deep Learning Techniques

K. Kaviyadharshini, S. P. Abirami, R. Nivetha, M. Ramyaa, and M. Vaseegaran

Abstract Languages like sign languages rely on manual gestures to communicate. As effective means of communication for the deaf, sign languages were devised. It will be of great help for deaf and dumb people and also for people who have no knowledge of sign language. This eliminates the need for an intermediary as a translation medium. The number of sign languages used worldwide is unknown. Typically, each nation has its own native multiple languages. The primary goal of this study is to recognize the poses and hand gestures of all kinds of sign languages available worldwide and convert them into text and audio and making the system bilingual. This system tries to build a communication bridge between people with hearing and speech impairments and the rest of society. So far, many researchers have studied this area to get a better result. In this research work, the conversion of sign language to text and audio is carried out using techniques such as Media Pipe Holistic, Drawing Landmarks, Open CV, LSTM Neural Network, Google Translator, and GTTS in order to achieve a good accuracy of 98%. This model can be further improved by adding various language conversions for better performance.

Keywords Gesture recognition · Sign language recognition · Key points · Media pipe holistic · Open CV · LSTM neural network

1 Introduction

This system's major objective is to aid those with speech and hearing impairments in connecting with regular people. It's a method of communication without words. The structured form is sign language, where each gesture denotes a certain concept or personality. With the development of science and technology, numerous researchers

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are working on numerous strategies that could raise the level of human–computer connection. Both static and dynamic frames can be translated into text by the computer thanks to its training. The system is set up and intended to recognize postures and movements used in sign language and to instantly display the relevant text and music for a given action. Videos are pre-processed after being recorded. Key ideas are compiled using the holistic media pipe approach [2]. Video pipe Holistic gathers important information from the hands, face, and body. The video is accessed, recorded, and transformed to N frames using the Open-CV webcam. To train and test the model, key point values are gathered. The LSTM method is used to train and evaluate the model (Long- Term and Short-Term Memory) [1]. With the help of Google Translate, the corresponding English word is translated into Tamil. Later, the Tamil word is converted to audio using a library called GTTS and played immediately. By importing GTTS any Tamil word can be converted into the corresponding audio format. Thus, this model converts a character into its respective English text and as a bilingual model to its respective Tamil audio production model.

2   State of Art

Many theories have been proposed related to employing machine learning and deep learning to translate between sign languages. This literature review focuses and covers a wide variety of such related topics.

P. Ushasri et al. (2022) proposed a method that can identify hand poses & gestures from Sign Language in real-time using CNN and RNN. Using this methodology, the system is able to achieve a good model for gesture prediction.

R. Harini et al. (2020) suggested a system that tries to achieve computer vision that can instantly translate user-provided signs into text. Four modules, including picture capture, pre-processing, classification, and prediction, are included in the suggested system. CNN is employed by proposed system to transform sign gestures to text. The model's accuracy is 99.91%.

A normal digital camera was merely utilised to acquire the signs; no wearable devices were necessary to capture electrical signals, according to Ashok Kumar Sahoo (2021), who describes a system for automatic recognition of ISL immobile numeric signs. Since each sign image submitted must have exactly one numerical sign in order for the system to translate solitary digit signs into text, In terms of classification accuracy, it employs two classifiers: k-Nearest Neighbor and Naive Bayes.

From the review of sign language conversion to text utilizing techniques from deep and machine learning it is observed that the choice of using Deep learning algorithms which will be a good choice to convert sign language to text.

3 Proposed System

The primary goal of the research project is to use deep learning and machine-learning algorithms to interpret sign language to text and audio. The input to this model would be a real time sign video which is treated as dataset to this model. Initially the model was tested with 4 words which include "Hello", "Thank you", "Please" and "Help". This research work incorporates Media pipe Holistic Library for finding and extracting the key points from Face, Hand and Body. Another important library called Open CV that is employed to support a variety of applications, including facial recognition, object tracking, landmark recognition, and more [6]. In this work it is used to access web camera in order to detect human face. Utilizing the LSTM (Long Short Term Memory) deep learning method, the work is trained, tested and evaluated. Further the model is carried out by incorporating Google translator to convert the corresponding English word to Tamil word in order to make this model as a Bilingual [4]. The GTTS library is used to convert Tamil word into Tamil Audio. Figure 1 depicts the flow diagram of the shows initially a video is feed into the application via a webcam. Then the video is divided into frames and from that the key points are taken from each frame and those key points are stored in form of vectors in a stored database. The data from the database is portioned for training and testing data. After that the training dataset is given to the LSTM model and trained till the accuracy level reaches the satisfaction. If not the model architecture is fine tuned to reach the required accuracy level. Then classification using the trained model is done. This gives the output as words that resemble the sign in the video. After delivering the words the system gives the respective Tamil audio of the signs [9].

3.1 Media Pipe Holistic

The MP holistic library is used to extract the important details from hands, faces, and bodies. In this model, holistic tracking is leveraged to track 33 poses, 21 per hand, and 468 facial landmarks simultaneously and in a semantically coherent manner. With the help of media pipe total 1662 key points are captured, processed and detected and fed into our model to get the exact word for the corresponding sign.

3.2 Open CV

A cross-platform library called Open CV is used to create applications for real-time image processing. The Open CV library is capable of reading and writing images, recording and saving videos, processing images (filtering, transforming), performing feature detection, identifying particular objects—such as faces, eyes, or cars—in

Fig. 1 Flow diagram of the
proposed approach
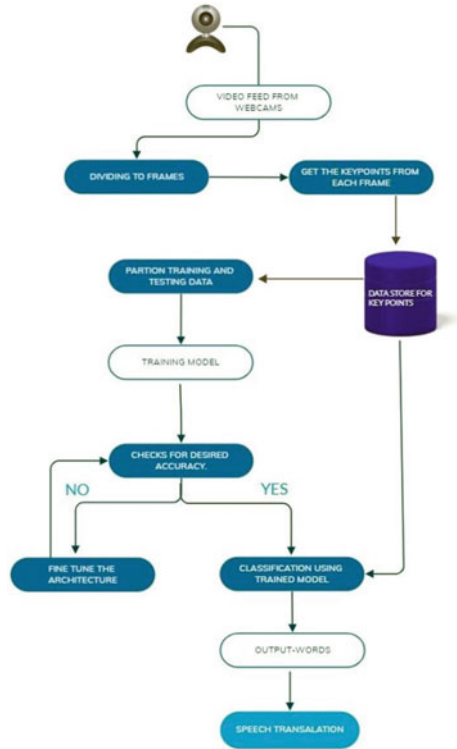
images or videos, and estimating the motion in videos by removing the background
and tracing objects in them [3]. In this model, Open CV is utilized to record video
and find important regions on the body, hands, and face. With the help of this library,
our computer's webcam is accessed and the final result can be shown to the users in
an obvious way.

3.3 LSTM (Long Short Term Memory)

LSTM is an RNN variant (Recurrent Neural Network). It is a sequential network
that enables the persistence of information. It can deal with the long-term depen-
dency problem, which arises when RNNs need to remember information for extended
periods of time. LSTM in general has a cell state and 3 gates which selectively learns,
unlearns or preserve information from each of the units. The cell state enables the
information to by skip through the units without being altered. Each component
includes an input gate, forget gate, and output gate. The information can be uploaded
to the cell state and removed from the cell state with the help of those gates. The
forget gate decides which information from the previous cell state has to be forgotten,

and it does so by using the sigmoid function [8]. It exams at h_{t-1} and x_t, and outputs a variety of among zero and 1 for every quantity with inside the cell state C_{t-1}. A 1 represents "absolutely hold this" and zero represents "absolutely dispose of this". The formula used to calculate the information to be forgotten is given below

$$f_t = \sigma(W_f.[h_{t-1}, x_t] + b_f)$$

The old cell state in this instance is C_{t-1}, and the new cell state is C_t. The following step is to add new data that will be stored in the cell state. The value to be updated is decided by the input gate layer (sigmoid layer). A vector of potential new values that could be added to the state is created by the tanh layer. Below is the formula for calculating the sigmoid layer and tanh layer function.

$$i_t = \sigma\left(W_i.\left[h_{t-1}, x_t\right] + b_i\right)$$

$$\tilde{C}_t = \tanh\left(W_c.\left[h_{t-1}, x_t\right] + b_c\right)$$

The new data must then be added to the cell state after the old data has been removed. Following is the calculation formula for this technique.

$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t$$

Finally, designers must determine what to display. This output, however filtered, will be based on the state of our cell. The first step is to employ a sigmoid layer to choose which components of the cell structure will be released. Then, in order to extract only the sections we have chosen to make, we multiply by the sigmoid gate result after setting the cell state by tanh (to push the values between -1 and 1).

$$O_t = \sigma\left(W_o.\left[h_{t-1}, x_t\right] + b_o\right)$$

$$h_t = O_t * \tanh(C_t)$$

3.4 Google Text to Speech (GTTS)

An MP3 file can be created using the Python package GTTS to turn the entered text into audio. English, Hindi, Tamil, French, German, and a host of other languages are among the many that the GTTS API supports. In this model it is used to convert Tamil text to Tamil audio and the audio will be played at the time of detection making the system as a real time model.
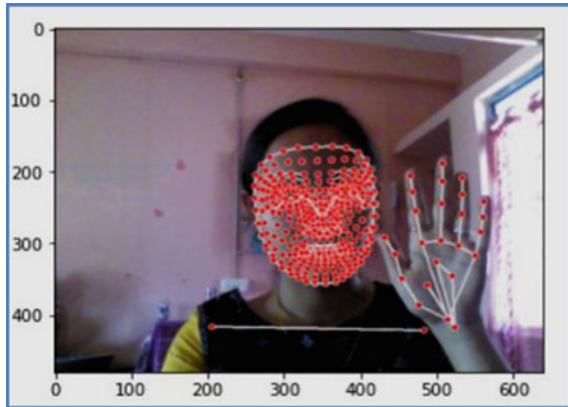
4 Overall Findings and Discussion

4.1 Input Dataset

For model training, the input dataset has been provided. The input dataset contains seven words of action such as 'HELP', 'THANKS', 'PLEASE', 'HELLO', 'MILK', 'FOOD', 'WANT'. This input can be merged to get complete meaningful sentences. Here a collection of 30 videos is taken as training dataset for each sign which is then converted to array format. Each video is divided into 30 frames and from that the key points are extracted.

4.2 Open CV and Media Pipe Holistic

The pose landmark involves 33 key points, Face landmarks involve 468 key points, Left hand landmarks involve 21 and right hand has 21 landmarks in total 1662 landmark (key point values) has been collected for each frame and the results are stored in an array [7,10]. Figure 2 displays the outcome of the model discussed previously.

4.3 LSTM Model

Input given to this model, X = np.array(sequences) in the shape of (30, 1662) to the first layer. All 1662 features (key points [30 frames for each video] for all the 4 signs) will be equally divided and connected to 64 units of the first layer. The output of this layer will be 30*64 matrixes because the return sequence is fed to the subsequent
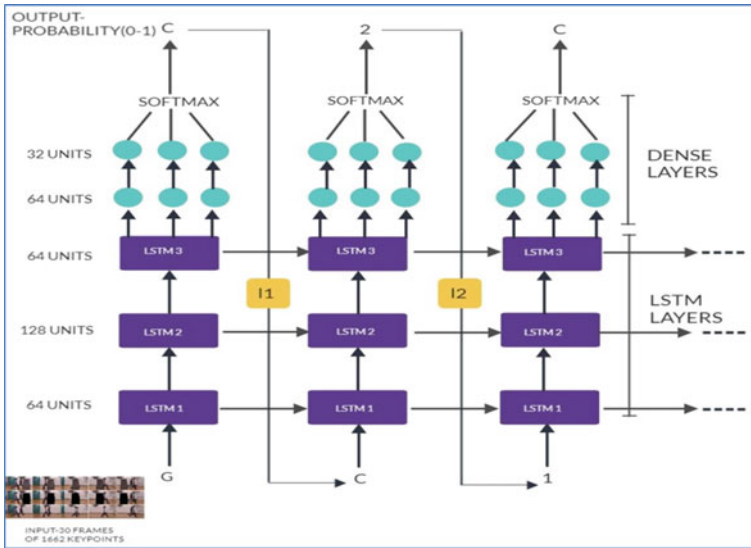
Fig. 3 Diagrammatic representation of LSTM Model

LSTM layer and is given as True in the first LSTM layer [5]. Similarly for second layer the output will be 30*128 matrixes and it is given to the next layer. In the final layer the return sequence is false so the output of this layer will be 64 and is given to the dense layer. The same function happens in the dense layer. As employed in this research, the LSTM model's diagrammatic representation is depicted in Fig. 3.

4.4　Google Text to Speech

The Google Text To Speech Translator implemented with improved accuracy. The Translator is used to convert the Tamil word to Tamil Audio and the converted audio is played at the time of prediction. The output of the converted audio at the time of prediction will be in the form which is shown in Fig. 4. The result of applying all the functions and libraries to the dataset and the dataset is trained and tested using LSTM model in order to convert the sign to English text and Tamil Audio and the final output of the project is shown in Fig. 5. The output of the model that gives the respective Tamil audio with the help of GTTS is shown as in Fig. 6.

Here the output is received in the form of both English and Tamil word in which the Tamil words is delivered as audio using the GTTS algorithm and the English words are printed in the screen at the top of the window. This process happens simultaneously where English words are displayed and the audio is delivered from the Tamil words. The English words are printed in a sequence form at the top of the window.
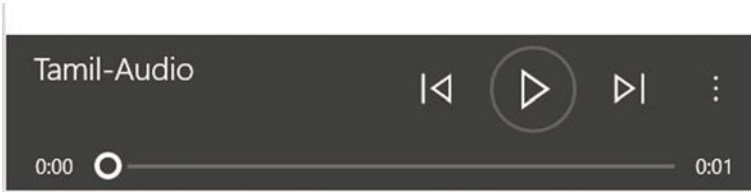
Fig. 4 Audio output
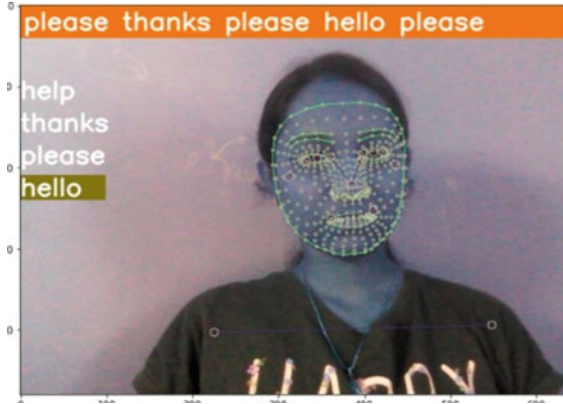
Fig. 5 Output of the model

Fig. 6 Output of audio for sign

5 Conclusion and Future Work

Since sign language conversion to text as well as audio is an important concern from which many people will get benefited. The proposed system is implemented using Media pipe Holistic library for detecting Key points from the video, Open CV is used to access the web camera during the dataset collection and during the testing time, LSTM Neural network is the main model of this project, used to train the dataset

and a Translator is used to translate the English word to Tamil word, GTTS is used to translate the Tamil word into its corresponding Tamil Audio. The sign video is given as input to the model which is trained and tested using LSTM algorithm and 98% accuracy is achieved using this model. The corresponding English word for a specific sign is displayed along with its Tamil audio is achieved in this system. Further multiple language conversions can be incorporated into this model making it as a multilingual model.

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Security Attacks and Key Challenges in Blockchain Technology: A Survey

Rima Patel and Dharmendra Patel

Abstract A blockchain is decentralized, distributed and public ledger, which is used to record the transaction across the number of clusters of computers. The record cannot be altered without an alternation in subsequent blocks. In the world of IT, the term Blockchain is not obscure. Despite tremendous applications in the field of information technology, finance and other industries, there are some challenges with Blockchain technology that need to be taken into consideration. In this paper, we have discussed the key challenges and issues with Blockchain technology.

Keywords Blockchain · Digital signature · Smart contract · Crypto currency · Consensus mechanism · Proof of work (PoW) · Proof of stake (PoS) · Proof of authority (PoA) · Proof of elapsed time (POET) · 51% attack · Race attack · Smart contract attack

1 Introduction

Blockchain is a concept that combines several topics such as cryptography, mathematics, networking, distributed consensus technology, algorithms, and so on [1]. Blockchain is a technology that runs bitcoin and Ethereum. In 1991, Up until the middle of the 2000s, Stuart Haber and W. Scott Sternest worked on developing a cryptographically secure chain of blocks. The initial blockchain was conceived of by Satoshi Nakamoto in 2008, and it later became an essential part of Bitcoin [2]. Ethereum and bitcoin are both open-source blockchain technologies. Hyperledger

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and R3 Corda are two others private blockchains. In its most basic form, a blockchain is a time-stamped database of unchangeable data that is administered by a network of computers as opposed to being held by a single entity. It is extremely challenging to modify data once it has been stored on the blockchain. Each of the blocks of data are connected with each other by cryptographic principles known as chains. The reason behind the attraction towards this technology is, it carries no transaction cost. Blockchain is the simplest yet inventive way of passing information from source to destination in a fully safe and automated manner. These blocks are validated by the billions of computers scattered over the internet. The block after verification, is added into the chain, and if anyhow the record of the block were compromised, would in turn compromise the chain of record. This is virtually impossible. In the following sections, we have discussed the working of blockchain and different types of issues and challenges that need to be solved for deployment and implementation. Section 2 depicts the fundamentals and working of the blockchain. Section 3 explains the evolution of blockchain technology. Section 4 represents the types of attacks in blockchain technology. Section 5 depicts the issues and challenges of blockchain technology.

2 Fundamentals and Working of Blockchain

This section briefly describes the working of blockchain technology. The three pillars of Blockchain technology are decentralization, transparency and Immutability.

The technology comprises three main components.

(1) Transaction: It is described as the participant-initiated action.
(2) Block: A block is a grouping of data in a blockchain that includes its own hash value as well as the previous block's hash value.
(3) Chain: Each block is connected with each other via the cryptographic rules known as chains.

Other than these three components, the term smart contract is one of the important tem while working with blockchain technology. A piece of code called a smart contract utilises technology. It includes the set of guidelines that all parties to the transaction will concur to follow. Issues with the current banking system are the high charges for transactions, long time involved in banking, fake currencies can create problems of double spending and the banks can collapse at any time. Figure 1 shows that the digital wallets like PayPal, Paytm and Citrus allow us the instant transfer but still depend on the bank.

Figure 2 depicts how the traditional online transaction works. The two parties participate in the transaction but they are dependent on the trusted third party. A trusted third party's job is to verify, protect, and maintain the transaction [3]. The chances of fraud using a trusted third party can be avoided to some extent, but still, it is not completely avoidable. In addition, the transaction cost is high using traditional financial online transaction systems. Where in the blockchain technology, bitcoin
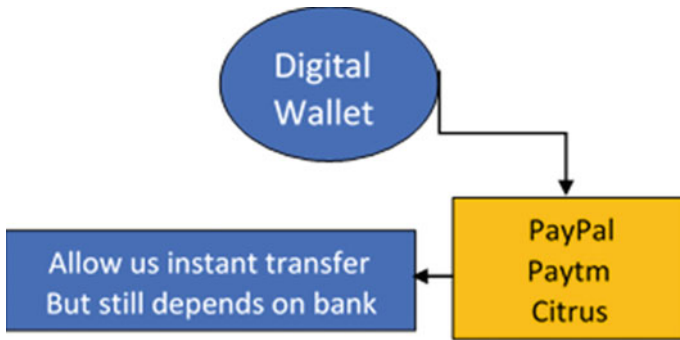
Fig. 1 Dependency of digital wallets

uses cryptographic proof instead of third-party trust [3]. By enabling peer-to-peer (P2P) transactions without the use of an intermediary like conventional commercial organizations, blockchain, the technology that powers cryptocurrencies, ushers in a new era [4].

The transaction is protected through the digital signature. Digital signature comprises the two phases: signing phase and verification phase. Each transaction is digitally signed with the sender's private key before being transferred to the receiver's public key. In Fig. 3, the user Alice first signs the transaction by generating the hash derived from the transaction. The generated hash value is used to encrypt the signature by using the private key of Alice. Bob, the user at the other side receives the encrypted hash with original data. If the owner of the crypto currency wants to spend the money, one has to prove the ownership of the private key. This can be done at the receiver side. In Fig. 3, Bob confirms the transaction by comparing the decrypted hash to the received hash using Alice's public key.
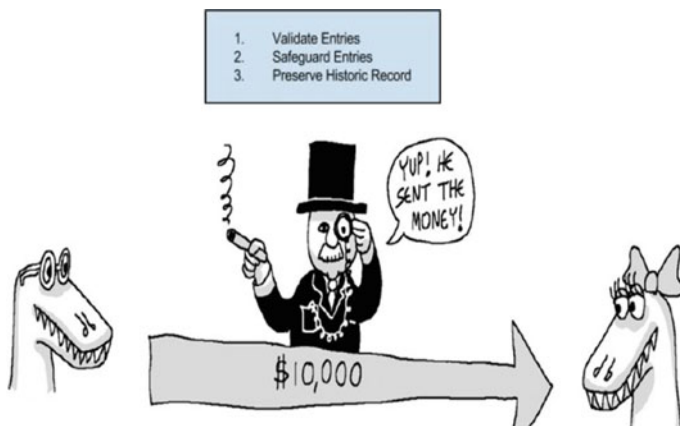
Fig. 2 Traditional online financial transaction using third party [3]
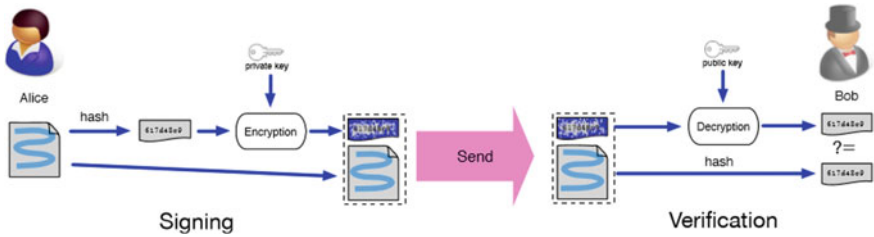
Fig. 3 Digital signature [5]

To understand how the digitally signed transaction is recorded into the chains of blocks, one needs to understand the architecture of blockchain. Figure 4 represents the arrangements of blocks in the blockchain. As shown in Fig. 4, blockchain is the linked list-like data structure in which blocks are connected with each other cryptographically. The transaction is permanently stored on the files known as blocks. The "genesis" block is the very first block on the blockchain. It is nearly impossible to hack the block in chain because it contains both the previous block's hash value and its own hash. If it is possible to hack, it would be like a robber not only robs the bank but also takes all the data. A cryptographic hash function converts a single, fixed-length binary output (i.e., an image) from a random binary input of any length. Using a secure hash function, such as SHA-256, it is computationally impossible to recover the input from the output image [6]. Furthermore, it is extremely unlikely that any two separable inputs will result in the same outcome [6]. Apart from the hash, each block in the chain contains the address of the previous block, transaction + hashes and nonce.
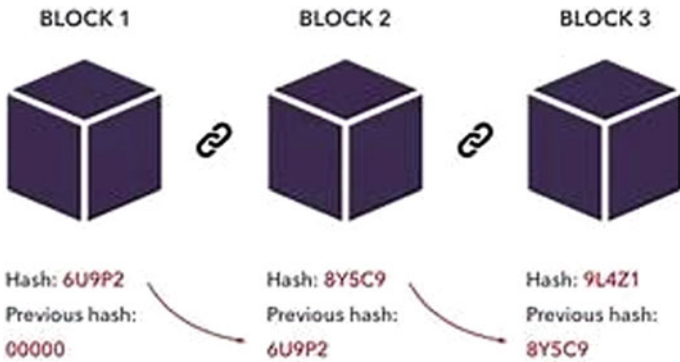
Fig. 4 Blocks in Blockchain

3 Evolution of Blockchain Technology

Satoshi Nakamoto as the first application of blockchain technology introduced Bitcoin in 2009. After the successful evolution of bitcoin cryptocurrency, blockchain was used in many sectors like IoT, healthcare and finance etc. This was the era of Blockchain 1.0 known as cryptocurrency. It is an example of public blockchain (Fig. 5).

In the second of its evolution, along with the cryptocurrency, business logic was added which is known as smart contracts and the era is known as Blockchain 2.0. Smart Contracts are the scripts written by developers as a transaction instruction which will be executed when some event will be triggered on the Blockchain network. Ethereum was started in May, 2015 which is a widely adopted Blockchain application that uses smart contracts [7]. The Decentralized App (DApp) can be defined as the evolution of Blockchain 3.0. With the rapid growth of computing technology, the requirement of decentralization also increases. The DApp can be considered as a smart contract running in a decentralized environment [7]. Currently, it is an era of Blockchain 4.0 in which many industries are focusing on implementing Blockchain according to Industry standard 4.0 [7]. Based on the access permission, blockchain can be classified into public or permission less and private or permissioned blockchain. Consensus mechanism is the inseparable concept with computer systems and blockchain technology, which helps to achieve the agreement between the two parties Different consensus algorithms, have different parameters to add the block in the blockchain. Following are some of the different types of the consensus algorithms. The famous Byzantine generals must be acknowledged when it comes to the consensus method. Leslie Lamport initially proposed the Byzantine generals' dilemma in 1982 in "The Byzantine generals' problem" [8].

PBFT Byzantine Fault Tolerance Algorithm: Castro and Liskov's 1999 chain of alliances with the enterprise proposal is largely used by PBFT. Rogue nodes may be

Fig. 5 Evolution of Blockchain technology
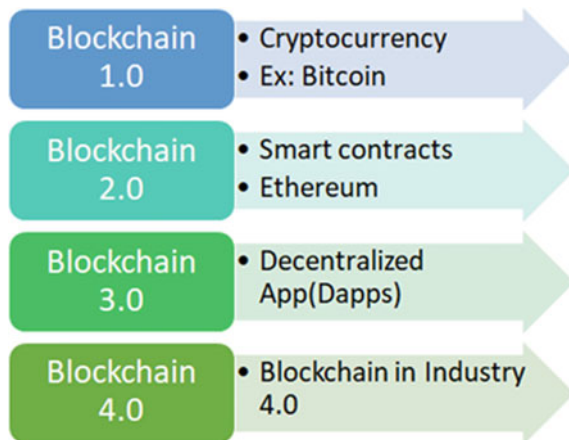
tolerated under Practical Byzantine Fault Tolerance (PBFT) [9] if they account for less than one-third of all nodes. This algorithm is based on the byzantine general's problem. In this case, we apply dilemma of blockchain to solve the problem where generals can be considered as a node. All of the nodes must agree on the current state of the system. Majority participants have to agree in the same action to avoid failure in the distributed system. Consensus mechanisms can be used to overcome the problem of the Byzantine generals. In a distributed system with many dispersed nodes, the numerous nodes must bargain with knowledge about the untruthful nodes in order to create a correct judgement [10]. By efficiently obtaining the permission of these nodes, the consensus mechanism strives to achieve the Blockchain's verifiability and tamper-resistance [10]. Even if some nodes fail to communicate or act maliciously, a byzantine fault tolerant system can keep running.

Proof of Work: In 2008, Nakamoto S. Bitcoin [11], PoW consensus, which belongs to unlicensed consensus, was proposed [10]. In case of PoW nodes will spend the computing power, do some computation, solve the puzzle and whoever wins the calculation puzzle they will add the block in the blockchain. The one, who adds the block in the blockchain, will get the reward as the nodes are spending the computational power, node can be trusted. The idea behind PoW in terms of blockchain is to find or generate the value which is either difficult to generate and easily verifiable. Bitcoin uses the PoW consensus.

Proof of Stake: In the Bitcoin talk forum in 2011, Quantum Mechanic suggested the proof-of-stake (PoS) Proof mechanism [10]. The PoS consensus mechanism is an alternative to the PoW consensus mechanism's resource waste and security flaws [10]. In proof of stake, there is no puzzle to compute and there is no reward for doing so. Instead of reward, the miners will get the fees for the transaction. Coins must have been held for a minimum of 30 days before they can compete for blocks. In 2013; Vitalik Buterin founded Ethereum [12]. In early 2016, ethereum technology was recognized by the market and ethereum proposed the Casper consensus mechanism based on the POS mechanism [13].

Proof of Authority: In this consensus mechanism, a group of validators is already chosen as authority. The trusted set of nodes will act as a validator. The group will produce the block at fixed regular intervals. PoA can be used or adopted as a solution for private networks rather than public blockchains.

Proof of Elapsed Time: POET was designed to improve upon Pow consensus and provide an alternate for permissioned or private blockchain. Each node is assigned waiting period by the network in order to mine. There are many other consensus algorithms like PBFT, DBFT, Bitcoin -NG, Proof of Luck can be used based on the application scenarios of blockchain. Different application scenarios require different types of Blockchains [14]. Apart from the wide range of applicability of blockchain technology, some issues catch the eye of researchers. In the Following section, different possible attacks in Blockchain are summarized. Some of the potential assaults in blockchain include attacks on the blockchain network, user wallet attacks, smart contract attacks, and attacks on transaction verification mechanisms. In contrast

to the OWASP list, there aren't many security recommendations and tools for the rapidly popular blockchain technology [15]. The following vulnerabilities also apply to blockchain technology: Injection, Broken Authentication, Sensitive Data Exposure, XML External Entities (XXE), Broken Access Control, Security Misconfiguration, Cross-Site Scripting (XSS), Insecure Deserialization, Using Components with Known Vulnerabilities, and Insufficient Logging and Monitoring [15]. Attacks such as selfish mining, the 51% assault, DNS attacks, distributed denial-of-service attacks, eclipse attacks, fork after withholding attacks, and consensus delay are all made possible by the peer-to-peer architecture that the Blockchain is built upon [16]. Section 4 depicts the different types of attacks, the effect of attack along with the prevention and/or the year of attack when it happened.

4 Security Attacks in Blockchain Technology

Sr. No.	Type of attack	Remarks	Year/prevention/example
A. Blockchain network attacks			
1	Distributed denial of service	• Hard to execute, but possible • The attacker attempts to knock the server down by utilizing all available resources by making a large number of requests • Hackers attempt to disrupt mining pools, e-wallets, bitcoin, and other financial services on networks	2017-bitFinex attacked by DDOS 2020-bitFinex
2	Transaction malleability attacks	• To make attack Successful to, the victim is tricked for paying twice • Attacker if manages to alter the transaction ID, broadcast the changed Hash of transaction and confirm it before proceeding with the original transaction • If this is succeeded, sender believes that the original transaction fails and if initiate, the transaction again then account will be debited twice	2014-Mt.GOX was bankrupt because of malleability attack in 2014

(continued)

(continued)

Sr. No.	Type of attack	Remarks	Year/prevention/example
3	Time jacking	• Takes advantage of a possible flaw in bitcoin's timestamp handling • A node's network time counter is changed, and the node is forced to accept a different block chain • If inaccurate timestamps have been added in the network with multiple fake identities, attack will be successful	Prevention: By limiting acceptance time ranges and using the system time of the node
4	Routing attacks	• Has the ability to affect both individual nodes and the network • Divides network into partitions, so it is not possible for the peers to detect the tampering • Routing Attack consist of two types of attack, A Partition Attack in which network is divided into two separate groups • A delay attack, tampers with propagating and sends them to network	Bitcoin may suffer from the routing attack Prevention-SABRE network can protect the Bitcoin from partitioning attacks
5	Sybil attack and eclipse attack	• Multiple fake identities are created for same node • Attacker takes the control of multiple nodes that close up the transactions • Victim node is surrounded by the fake noes and becomes open to double spending • Attacker overwrites the tried table of victim node	• Quite difficult to detect and prevent • Eclipse attack on Ethereum network

(continued)

Sr. No.	Type of attack	Remarks	Year/prevention/example
6	Long range attack	• Target network that uses PoS Consensus • In this attack, attackers use purchased or stolen private key which has been used in past • An attacker might create a different version of the blockchain's history and boost rewards via PoS validation	Some of the countermeasures of Long Range Attacks are Longest Chain Rule, Moving Check Points, Key Evolving Cryptography, Context Aware Transactions, Plenitude Rule, Economic Finality and Trusted Execution Environment [17]
B. User wallets attacks			
1	Phishing	• The attacker used this service to launch a phishing campaign and control the log with secret seeds • Attacker generates the fake seeds	In 2018, hackers stole $4 Million from IOTA Victims' Wallets
2	Dictionary attack	• Attacker tries to break victims' hash and salt by attempting different hash values of common passwords like pasword123 • Salt is randomly generated value used to protect password • Easily guessed passwords can't be protected	Multifactor authentication can be used where possible. Strong password will be helpful to minimize the risk of Dictionary Attack
3	Vulnerable signatures	• To create user signatures, Blockchain Networks employ a variety of cryptographic algorithms	Bitcoin uses ECDSA has insufficient entropy, which can result in the same random value in more than one signature

(continued)

(continued)

Sr. No.	Type of attack	Remarks	Year/prevention/example
4	Attacks on cold wallets and hot wallets	• On Successful attack, researcher can obtained the private keys as well as the PINS, recovery seed and paraphrases of victims • Are web-based applications that store private cryptographic keys	• In 2019, hackers manage r Because they knew the timing of transaction for UPbit, attackers gained access to users' private keys provided by blockchain.info and stole 3,42,00 ETH Despite the fact that wallet owners vow to keep user data off the internet, In 2018, $500 million was stolen • XRP worth $4.5 million was stolen in 2019

C. Smart contract attack

1	Vulnerabilities in contract source code	• If a smart contract's code contains a vulnerability • Solidity's common vulnerabilities allow for the delegation of control over uncontrolled functions from one contract to another • Known as re-entrancy attack	In year 2016, bugs in Ethereum smart contract
2	Vulnerabilities in virtual machines	• Immutable defects—since blockchain blocks are inherently unchangeable, smart contracts cannot be modified once they are formed • As with the DAO assault, fraudsters may uncover and exploit code weaknesses in order to steal Ether or build a new fork • Bugs in access control, Short address attack	A change to the Coindash Ethereum address, for example, caused victims to send their Ether to the hacker's address during a successful attack on the Coindash ICO in 2017

D. Transaction verification mechanism attacks

(continued)

Sr. No.	Type of attack	Remarks	Year/prevention/example
1	Double-spending	• Due to insufficient or nonexistent security, an attacker is able to double spend the same amount, benefitting himself at the expense of others and removing the blockchain's immutability [18] • By fooling the system into using the same coins or tokens in multiple transactions, attackers might take advantage of the delay	Double Spending can be prevented by timestamping groups of transaction and then broadcasting them to all of the nodes in the Bitcoin network
2	Finney attacks	• A Finney attack is similar to the race attack where the receiving user accepts a transaction that has not been stored in the blockchain [19]	The only method to protect oneself against such an assault is to need at least one transaction confirmation before distributing purchased products
3	Race attacks, vector 76	• When an attacker makes two transactions that are incompatible, this is known as a race attack. The initial transaction is made to the victim, who takes payment (and, for example, sends a goods) without waiting for confirmation • Combination of Finney and Race attack	To avoid a race attack, the receiving user must wait for the transaction to be permanently stored before accepting it, ensuring that there are no additional fraudulent transactions on the network [19]

(continued)

Sr. No.	Type of attack	Remarks	Year/prevention/example
4	51% or majority attacks	• A majority attack occurs when a hacker gains control of 51 percent of the network hash rate and establishes a new fork that eventually replaces current forks • If an attacker has less than half of the processing capacity, double spending is still conceivable [20] • 51% of attacks are transitory, which means they cannot be detected later unless they are spotted at the time of the attack [21]	Verge, ZenCash, Monacoin, Bitcoin Gold, and Litecoin Cash have already suffered from 51% attacks

5 Challenges and Issues in Blockchain Technology

Every coin has two sides and so blockchain technology. Even though in the world of information technology and finance, this technology has greatly supported the area of security, it still faces some challenges. Listed below are some of the issues and challenges in blockchain technology.

(1) **Size and Bandwidth of Network**: As block chain is a faster growing technology, the number of users is also increasing. If a robust network is not supported by using a large number of nodes, it's impossible to take full advantage of blockchain technology.

(2) **Transaction Cost and Network Speed**: Bitcoin processes 7 transactions per second on average. The transaction-per-second rates of centralized payment methods like VISA are 2000 and for twitter its 5000 tps, so blockchain technologies need to get close, if not better. The details will be stored in each node, so the speed of the network is also one of the most important points to be considered.

(3) **Wasted resources**: According to 2015 data, the Bitcoin network spent $15 million per day on energy mining [22]. The Proof-of-Work effort in Bitcoin is the source of waste. The likelihood of mining a block will be determined by the miner's efforts [23].

(4) **Energy Consumption**: Blockchain technology works on Proof of Work concept. PoW is used to validate the transaction and it requires too much mathematical calculation. So, a large amount of energy is required for the computers used in the network to perform the particular task.

(5) **Complexity**: Blockchain is technology that runs bitcoin. Like bitcoin, blockchain technology has a wide range of vocabulary that needs to be adapted. And as security is a central point of attraction, complexity will automatically become a major point of discussion.

(6) **Interoperability**: Three different kinds of blockchain technology are public, private and consortium. Sometimes it may happen that only one type of blockchain cannot solve the problem of industry and at this stage, it is not possible to merge two or more types of blockchain technology. For the communication of the different types of technology, cross chain technology is required.

(7) **Time Confirmation of Transaction**: Transaction time for bitcoin is 1 h. Though it is less than the traditional online transaction system, which takes 2 to 3 days for confirmation, still the time can be reduced by using the "Layer2" protocol. The lightning network is layer 2 protocol, which enables the fast transaction between the participating parties.

(8) **Transaction Malleability**: In the block chain Technology, the user will create the transaction, sign it and then send it off to the network in order to get it mined. However, there is no way to provide the surety of user's ownership for digital signatures. An attacker could alter it and then rebroadcast a transaction, causing issues with transaction confirmation. This issue is known as data malleability or transaction malleability [23, 24].

(9) **Privacy Leakage**: There is a belief that blockchain provides better security to the user's sensitive data. According to a recent study, account addresses are linked to bitcoin transactions, indicating the user's identity [25]. The problems were leaked out of the user's identity [25].

(10) **Security**: As soon as security is concerned, integrity, availability and confidentiality are the major terms that need to be considered. Confidentiality will be low in blockchain technology as distributed networks are used. There are chances of 51% attack, in which one miner can get full control on the chain and can try to temper the data. Integrity refers to the accuracy and trustworthiness of data. Blockchain uses the Merkle tree for providing better integrity. It uses a cryptographic hash function.

(11) **Scalability**: As blockchain is now growing technology and is used in every field of business, scalability is one major issue that needs to be considered while implementing technology. As the number of users increases, the number of transactions also increases. By considering this, blockchain has become huge in size. Two other major points are throughput and latency while considering scalability.

6 Conclusion

This paper depicts the major challenges of blockchain technology. Despite the huge applicability of blockchain technology in the different fields, it still suffers from major

issues. However, it has not been said that all the issues will persist for a long time. Some of the issues had achieved attention and partially solved too. Different attacks and their prevention have been surveyed. In addition, the severity of the attacks, if successful, is discussed. As blockchain covers the public perceptions, politics and governing bodies, where there is a full involvement of government the issues will take time to get solved. To apply blockchain in any of the sectors, a consensus algorithm is required and is closely related to the application scenario. Hence, different consensus mechanisms are also discussed in the paper. Our future goal is to apply the blockchain in the education domain with efficient consensus mechanism to improve the system security and throughput.

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Advancing from Manual to Automatic Telecast of News for Deaf

Annu Rani, Vishal Goyal, and Lalit Goyal

Abstract Sign Language is the natural way for hearing impaired people to share feelings, views, and ideas with others. Today we live in the modern area, owing to which we can easily communicate with others at remote places. But even then, there is require a lot of research work to be done in the area of sign language. The existing approach used pre-recorded videos, pictures, and subtitles to represent signs. These methods are very expensive, takes a lot of time to upload and download on the network and consume a lot of memory for storage. To handle this issue a new approach is introduced named as HamNoSys Notation. HamNoSys is an international notation to write the sign language in the coded form of any country. The main target of our research will be the development of a system for automatic telecast TV (Television) news into Indian Sign Language (ISL) using Synthetic Animations.

Keywords Anchor · Deaf · News · Sign language interpreter · Subtitles · Telecast · TV

1 Introduction

Television telecast news is a combination of images and audio which gives sound and visual representation of facts and information about the world deemed noteworthy and creates interest of the viewers of a broadcasting system [17]. The main power of the television [8] is the television screen, and through that display, it attracts the viewers and helps the audience to listen and visualize the latest news and historical events. Television normal watchers enjoy the TV program through the communicative mode of hearing and sight [19]. However, where the viewers are deaf, they are unable to enjoy auditory TV programs, resulting in loss of access to auditory facts within the

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broadcast network [16, 22]. Closed captions and subtitles can be devices used by the director to bridge the gap in understanding for the deaf people community [7]. But closed captions and subtitles are not more useful because mostly deaf people have low to moderate reading skills and are not familiar with technical words [14]. Some TV channels started to broadcast the news in sign language with visible anchors and subtitles [5]; but in itself does not make a guarantee to follow to high-quality standard that provides the most favorable access for deaf people. There are no formal and professional guidelines available for human interpreters in media.

2 Manual Telecast Systems for Deaf

News for the Hearing Impaired "Doordarshan," Poothullil et al. [21] is Government of Indian news TV channel telecast news at 6:15 A.M, in ISL for the deaf community. Badhir News is a special news bulletin of Zee News [6] for hearing impaired people. This brings the updated news of every afternoon at 3.30 P.M for deaf people. ISH (India Signing Hands), Blee TV and Newz Hook are Indian YouTube channels that telecasts the entertainment, information, and daily news online which are in ISL, Voice over and captions along with subtitles. News for Hearing Impaired with India Today presented top headlines daily for the Indian deaf community. Subtitles appear on the TV screen on one side and live news shows on the other side along with a voice-over.BBC See Hear [13] is a monthly long-running magazine show for the hearing impaired community in the United Kingdom, telecast on Wednesday at 8.00 am on BBC Two channel [18]. BBC Breakfast [2, 24] on air from January 1983 was presented by David Ross and Francis Joseph Bough. It is a news program that brings the updated news every morning for hearing impaired people in the UK. The program is broadcasted in BSL from Monday to Friday 06:45–07:30, 07:45–08:15, and Saturday–Sunday, 07:00–07:30 on BBC News 24 channel. BBC News at One [12] is a lunchtime news program broadcast from Monday to Friday from 13:00 to 13:30 on BBC News 24 channel for the deaf community. RAI TG1 LIS [11], RAI TG2 Flash LIS [10], and RAI TG3 LIS are an average three minutes news bulletin in Italian Sign Language (LIS) for hard of hearing community. on RAI 1 channel. RAI 2 channel [26], RAI channel respectively. without any headlines. RTÉ News with Signing [20] In 1975, RTÉ News with Signing was launched for the deaf community in Ireland. [21]. NPO NOS Jeugdjournaal [15] and NPO NOS Journaal are TV news show in Netherland, presented news and entertainment programs for children in Dutch Sign Language. STAR Eidiseis and ANT1 News [23] bring daily launch time news for hearing disabled people in Greek Sign Language on the STAR and ANT1 channel channel. CYBC Eidiseis [1, 9] is a news program presented daily at 18:00–18:20 on RIKSAT channel Live stream in Cyprus. Al-Jazeera Al-Akhbar [4] is a sign language news program for deaf people throughout Arab countries in Arabic Sign Language. RTVE in sign language [3] in 2008, RTVE in sign language was launched for hearing impaired people in Spain. It brings the weekly news summary for the deaf community in Spanish Sign Language with subtitles and voice-over. SABC News:

Table 1 A comparative analysis of news show with sign language interpreters

Channel	News show name	Language	Time	Sign-language	Context-of news	Country
DD National	News for the hearing-impaired	English	7:15–7:30 a.m.	ISL	Updated news	India
Zee News	Badhir News	Hindi	3.30 p.m.	ISL	General awareness	India
BBC News 24	BBC Breakfast	English	6:45–7:30 a.m.	BSL	Updated news	UK
BBC News 24	BBC News at One	English	13:00–13:30 p.m.	BSL	Updated news	UK
AI-Jazeera Arabic	AI-Jazeera	Arabic	18.00–18:10	ArSL	Brief news	Arabic
RTE News	RTE News with Signing	Irish	17:50–17:53	IrSL	Brief news	Ireland
SABC3	SABC	South African	–	SASL	Daily news	South African
CCTV	CCTV	Chinese	18:00–18:15	CSL	Social news	China

This news program brings daily news updates on the SABC3 channel for hearing disabled people in South Africa [25]. The analysis of various news channels are shown in Table 1.

3 A System that Automatic Telecast English News for Deaf

The architecture of proposed system is shown in Fig. 1.

- The user gives input in the form of English news content. Then the parser module parses the text according to part of the speech tag. After this, the phrase reordering module reorders the text according to the grammar rules of sign language. The reason behind this is that both language English and Sign have different grammar rules. So word to word mapping is not possible. After this eliminator module removes unwanted words like helping verbs, modals, articles, inflections, etc. from the text. Because sign language has no sign for these unwanted words. Then Lemmatization module gives the root form of the text. Then root word is mapped with SiGML file that is stored in the ISL dictionary database. If the SiGML file is found then corresponding action is performed otherwise finger spelling is
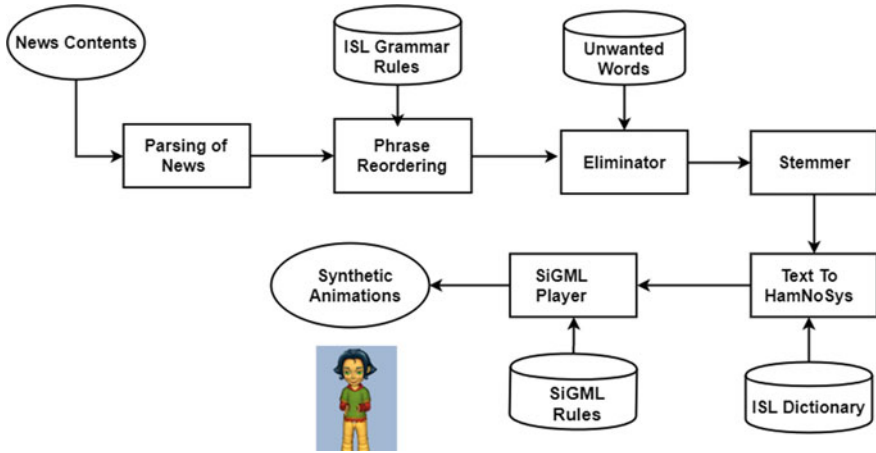
Fig. 1 Block diagram of English news to ISL

performed. All these SiGML files were prepared using HamNoSys code because SiGML files consumed less amount of memory for storage as compared to human videos.

3.1 Description of the Translator

The translator's underlying dictionary includes approximately 5000 terms corresponding their synonyms and inflections, most of which are drawn from news channels as DD news, Blee TV etc. An easy-to-use interface has been given for the translation. A screenshot of the translation software's user interface is shown in Fig. 2.
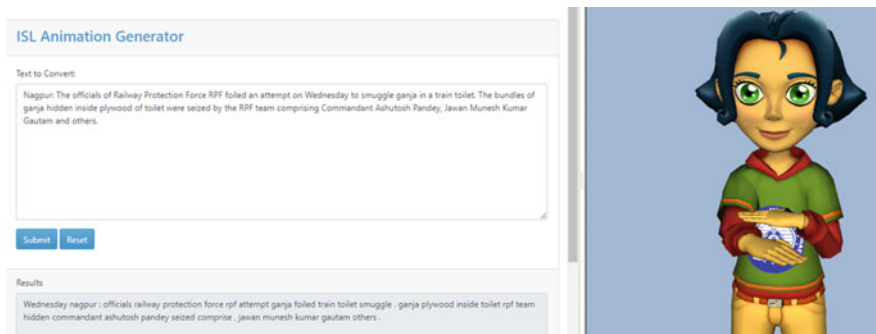
Fig. 2 User interface of automatic telecast news to sign language

In the translation system, the user must type out the whole news in the Input Text section to frame an input data. If a word is not found in the underlying dictionary, finger-spelling is show corresponding to unknown words.

4   Conclusion

Automatic translation of spoken/text language to sign language is a very difficult job because there are no-standardization material and grammatical rules of gesture language of any country. This paper presents the approach for automatically translating the news into Indian sign language by using synthetic animation. Although Synthetic animations do not look natural as pre-recorded human videos but synthetic animations are efficient in terms of translation time and computer storage used. These synthetic animations can be easily uploaded and downloaded over the network immediately constructing the real-time conversion from English text to sign language. The work can be carried out to implement the automatic translation of TV news to Indian Sign Language.

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Study of Nutrition-Based Recommender System for Diabetes and Cardiovascular Patients Based on Various Machine Learning Techniques: A Systematic Review

Nirav Mehta and Hetal Thaker

Abstract Nowadays, nutrition-based food is so essential for humans to maintain their good health. There is much research work that has taken place in India to resolve the problem. Considering this as a serious problem author tries to identify certain major diseases that do have a role to play in having good health. Diabetes and cardiovascular activity were used as a starting point for the author's evaluation. The author also investigated another aspect of nutrition-based recipes using a health recommendation system. There are many Recommendation Systems available for the user, and the author identifies that there is a lack of demographic base recommendation, so for that author, try to understand the filtering methods of machine learning and the model working based on different types of filtering methods which will help such people to find the right recommendation for nutrition base recipes for the good health. The purpose of this paper is to delve into a major research area by recommending recipes for nutrition-based foods to people. According to the survey of these papers, the author believes that further research can yield more effective results for the people of Gujarat. According to the author, this uses a multi-criteria sorting process to discover the closest match for the nutrition base meals for the individuals who would give the nutrition base food.

Keywords Nutrition · Recommendation system · Machine learning · Filtering methods · Content base filtering · Collaborative base filtering · Hybrid filtering · Demographic filtering · Multi-criteria sorting

1 Introduction

Generally, every person in the world needs good and healthy food to survive the many problems. This is one of the major problems: what kind of food do you eat for proper nutrition? In this paper, the author tries to review those papers which are

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helpful for those people who want to eat a good nutrition-based diet and want to maintain their good health for the future.

In this paper, the author reviews the papers based on the Nutrition Recommendation System, Filtering Methods, and Diseases like Diabetes and Cardio Vascular Activity. The author identifies that the major problem of cardiovascular will rapidly increase in the people of Gujarat. In this review, the author finds many types of recommendation systems and filtering methods based on how researchers apply the recommendation system to nutrition-based food recipes. The author also observes that the researchers work on the different types of filtering methods of machine learning. As per the author's observation, there are gaps available to solve this problem in Gujarati people. For that, they apply the season-based food to the user and also try to make Gujarati food for the Gujarati people so they can easily get the availability for that particular nutrition. Hence the author tries to observe each & every filtering method and based on that tries to create one analytical reviews for that from which every aspect of the filtering methods is comprised easily.

2   Literature Review

In this Literature Review, the paper author identifies the papers related to the different types of the recommendation system and Filtering methods of machine learning. Based on that review author identify the major diseases which rapidly increase in the Gujarat region which is hypertension so for that problem solution author observes that good nutritious food is one of the better options to deal with these major diseases of Gujarat people.

2.1   Filtering Methods

Content-Based Filtering Method: Content-based filtering is one of the types of recommendation systems that suggest things to the user based on the activities they have performed. In this given image, we can able to see that there are two users who both are watching a similar movie so based on that activity profile of the user content is generated for both users so based on that the filtering method will suggest a similar movie as they watch before to both the user this concept is simply known as a content-based filtering method (Fig. 1).

Review of Content-Based Filtering Method

Pallavi Chavan In this system the researcher accepts the past data that what kind of food they eat so based on that this proposed system will recommend the user good & healthier food. This research adopts the Cross-Industry Standard Process for Data Mining (CRISP-DM), this will provide the framework for data mining. With the use of this model of the Content base they get the accuracy up to 5% so far that it will take
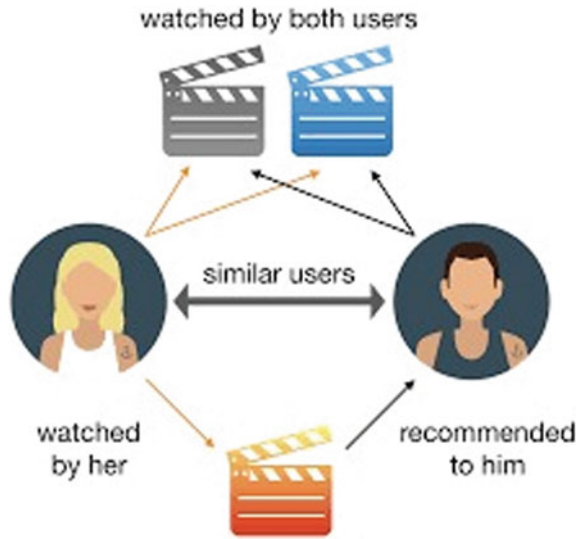
the data of recipes around 52,821 with the around 20,000 users are there to check this model [2].

Raciel Yera Toledo

In this developed system the researcher tries to recommend the food recipes as per the user preferences which means they can able to suggest the food as per their body. As per this system take the base as past behavior of the user and on the base of that, the system will recommend the food as per the preferences. In this developed system the researcher uses the multi-criteria sort AHPSORT. The recommended daily calories intake is determined through Basal Metabolic Rate (BMR), which is calculated by the Harris-Benedict coefficient. (BMR) Basal Metabolic Rate are used to justify the weight of men and women [3, 4].

Florian Pecune As per this system the researcher develop three different systems for the users which recommend the recipes to the user preferences so based on that this system will recommend the healthy food recipe to the user. In this system, the researcher use the 13,515 recipes from allrecipes.com amongst the 10 users. This system takes the nutrition-related data that will be worked based on the FSA (Food Standard Agency) of the UK [5].

Kashish Ahuja In this paper the researcher developed the software which accepts the customer experience & rating for the food recipes based on that user input the software will suggest or recommend such kind of food to the user. Also, this software gets feedback from the user at the end. This system uses python3 to develop this software with a machine learning algorithm with it. They use the CSV file as a dataset for the software [6].

Shumsher Rana, Kundan This system is used to recommend the food as per the nutrition's contained in the particular ingredients for that it is must that the particular

available in the database so for that the researcher have to design & develop the system as per the ingredients requirement for recommending the food to the user. The value of the nutrition is calculated based on the WHO—2010Food Agriculture Organization (FAO) and the International Food Policy Research Institute (IFPRI) data set. For this system, the researcher uses the python programming language with JavaScript & MYSQL as the backend of the system [7, 8].

Namrata Amane this system is used to provide the suggestion for the nutrition base food for the user as per their user preferences. This system also gives recommendation promotions, offers & tips to the user for healthy food. This system worked on the BMI parameter for recommending the food to the user. To design this system the researcher use the python programming language and test the results on 1000 users with 100 items [9].

Rui Maia and Joao C. Ferreira this system is used to recommend the context-aware recommendation system to the user for healthy food and based on the user preferences this system will suggest the healthy food to the user. This proposed system is also considered the different types of the patients like diabetic & high blood pressure. For this system, the researcher uses the 73,000 randomly selected rating events for the Food and Kochbar datasets & based on that testing the data on the many users [10].

Nilesh this proposed system is used for the recommendation of the recipes for the user based on the ingredients which are available in that particular recipe. For applying this particular system the researcher collected the data of different recipes with the included ingredients in it and then applies the filtering methods on it for getting the recommendation for the Indian cuisine-based recipes for the user. The data collection for the system is performed through the use of Web scraping is done using the scrapy1.5.1 framework. This proposed system will produce the performance of the system is based on the graph [11].

Ms. Nishigandha Karbhari this system is used to recommend the employee to the employer based on their marks which are obtained by the students. This system is generally developed for the placement to take place on the campus of the colleges. It is one of the major aspects which try to get resolved using this system utilization. This is system is very useful for both employee & employer to meet each other requirements. This system performs this task very easy to find the student amongst many based on their result which is obtained by them. For this system, the database is ready at the location in spreadsheets format [12].

Fujiang Sun this system gives the knowledge about the recommendation system working with the vague set available in the different areas. The researcher finds the problem to recommend the vague data so for the solution of that this system is developed by the researcher for performing the task easily. The vague set means uncertainty of the set means nothing is fixed in that so for that this system is developed for the recommending from those data. For this work, the researcher applied many methods to resolve this problem like Pearson similarity, Spearman similarity, Vectorspace similarity, Entropy, cosine method, and correlation Method [9, 13].

Tao Peng, Wendong Wang, XiangYang Gong, Ye Tian this proposed system is used for identifying the similarity between the content of the data. Many methods give the recommendation system based on the different parameters but there is a

problem regarding the similar content output of the data so for the solution of this problem the researcher tries to apply the graph indexing method which identifies the similar content from them using a content-based filtering method. In this author can derive the result on the base of precision values with the number of photos [14].

2.2 Collaborative Base Filtering Method

Collaborative base filtering is one of the newer & most popular methods for the recommendation system these days. This process is used to take preferences or information from the user &based on that it will automatically recommend the product or data to the particular user. In this following image gives the information on the base of like & dislike of the user & on the base of that model can able to predict the output or recommend the data related to that particular user (Fig. 2).

Review of Collaborative Base Filtering Method

Kashish Ahuja, the researcher developed the software which accepts the customer experience & rating for the food recipes that is known as a collaborative filtering criterion & based on that user input the software will suggest or recommend such kind of food to the user. Also, this software gets feedback from the user at the end. This system uses python3 to develop this software with a machine learning algorithm with it. They use the CSV file as a dataset for the software [6].

Namrata Amane this system is used to provide the suggestion for the nutrition base food for the user as per their user preferences. In this system, the researcher applied the collaborative filtering method to justify recommending the food recipe to the user as per their preferences. This system also gives recommendation promotions, offers & tips to the user for healthy food. This system worked on the BMI parameter for recommending the food to the user. To design this system the researcher use the python programming language and test the results on 1000 users with 100 items [9].

Fig. 2 Image for the collaborative based filtering method [15]

Priyash Verma In this paper the author tries to explain the detailed work of AI artificial intelligence-based recommendation systems works in different aspects of the world. These days many approaches are likely to build recommendation systems based on different filtering methods like Collaborative, Demographic, Hybrid, Content base working. To perform the different levels of recommendation use different kinds of algorithms that like ANN Artificial Neural Networks, Swarm Intelligence, Evolutionary Computing, Fuzzy Sets, etc. Genetic algorithms (GA) are speculative exploration methods that can be used to solve framework-building problems with unbiased purpose provisional hard and soft constraints. For customized R.S.s, GA-build K-means grouping remains practical in everyday online shopping marketplace separation situations, resulting in better-quality dissection display [16].

Hoill Jung in this proposed system the user tries to recommend the nutrition base food for the individual user. This system is working for the OBESITY for obese management for the individual user. This system automatically gets the temperature & CO_2 level if the air quality is poor then the device automatically gives the indication to the user. To develop this system they use the 4000 dietary nutritional contents for recommending the individual user the best food menu for them. Here, XML parser, form validator, request validator, and authorization are used. Data communication is connected with service and activity amount devices from the obesity management system, hospitals, clinics, schools, and fitness centers. CF_D F-measure was found to exceed the average of 80%. As a result of user cluster-specific F-measure comparison and analysis between KbCF_D and CF_D,KbCF_D was found to have better performance than CF_D in precision with 7.03%; recall, 3.87%; and F-measure, 5.54% [8, 17].

2.3   Hybrid Filtering Method

This is one of the most used filtering methods of machine learning for the better performance of the model. Hybrid filtering is nothing but it is a combination of the different filtering method which is available or use to get good performance & accuracy. In the following image, we saw that there is a combination of the two filtering methods which generate the results for the users so that is simply we can say Hybrid Filtering Base Model in machine learning (Fig. 3).

Review of Hybrid Filtering Method

Butti Gouthami this system researcher uses to develop software based on Hybrid filtering for the user to recommend them the proper diet as per their body requirement. In this system the dataset is taken from the USDA & BMI is taken as a base for recommending the proper nutrition base food to the user. This system uses the content & collaborative filtering method for the better performance of the system so this software is based on Hybrid filtering. BMI is one of the best ways to identify the individual body requirement for nutritious food. For the development of this system,
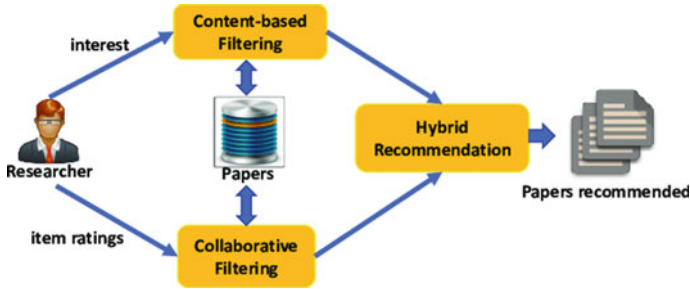
Fig. 3 Image for the hybrid based filtering method [18]

the researcher uses the Knapsack & TOPSIS algorithm to find the nearest nutrition's based grocery food or diet [19].

Thi Ngoc Trang Tran A hybrid system that combines strategies A and B seeks to "exploit the benefits of A to mitigate the drawbacks of B." For example, CF techniques must deal with the new-item problem. CB methods, on the other hand, can address this issue because new item prediction is frequently based on existing descriptions of these products. Burke discusses weighted, switching, mixed, feature combination, cascade, feature augmentation, and meta-level hybrid techniques that combine both CF and CB. The data on nutrition was taken from the German Nutrition Association, the Austrian Nutrition Association, and the Swiss Nutrition Association. As per this system if the user entered wrong data then the system will prefer the wrong output of the recipes this is the worst thing about this system. This system uses the XML-based Markup language to represent the user preferences in the database [20, 21].

Abhari S. In this paper the author tries to review the NRS (Nutrition Recommendation System) to recommend good and healthy food for the users and suggest them a good diet food to them. The PRISMA technique was used to guide the article selection process. From our preliminary investigation, the MeSH database, and expert opinion, we discovered keywords. PubMed, Web of Science, Scopus, Embase, and IEEE databases were searched. Following the evaluation, two independent reviewers received information from databases, and inclusion and exclusion criteria were applied to each recovered work to pick those of interest. Finally, 25 studies were included in the analysis. Hybrid recommender systems and knowledge-based recommender systems were the most commonly utilized recommender types in NRS, with 40% and 32%, respectively generating the results for the used datasets for the users. Rule-based and ontology techniques were commonly employed in NRS. The most often used platform in NRS was a mobile application, which accounted for 28% of the total … [22].

Raksha Pawar In this proposed system works with the different variety of the health problem related to the nutrients in the diet and eating disorders that may lead to chronic diseases such as cardiovascular disease, hypertension, diabetes. Vitamin B-1 deficiency is a typical form of nutritional inadequacy. Thiamine is another name for it. It improves the conversion of carbohydrates into energy in the body. Thiamine

shortage can harm nerves and muscles, and it can even harm the heart. For this system ,the python library is used for the extraction of data from a website. The data extracted is in a structured form. It is used to parse data from HTML and XML files. As per the future scope of this paper, we can add input options for user's BMI (Body Mass Index) and BMR (Basal Metabolic Rate) as well [23].

Gharbi Alshammari in this system presents a novel hybrid technique for indicating the closest users that integrate user-user CF with DF features, and we test four classifiers against each other. This method was developed as a result of research into ways to reduce rating prediction mistakes based on previous interactions with consumers, resulting in better prediction accuracy in all four classification algorithms. We used a feature combination strategy that improves prediction accuracy, and we used the 1 M Movie Lens dataset, well-known evaluation criteria, and method comparisons to test our approach, with the results confirming our suggested method [24].

2.4 Demographic Base Filtering Method

Demographic Filtering is a strategy that analyses a user's demographic data to evaluate whether things are suitable for the suggestion. The Content-Based Filtering technique suggests items to a user based on descriptions of previously rated items and information gleaned from the content. In this method, we can able to take the data based on season, age, gender, education, income, birthdates, etc. In the diagram, we saw that the same feature will recommend to the user this concept is known as the demographic filtering process in Machine learning (Fig. 4).

Review of Demographic Base Filtering Method

Maiyaporn Phanich in this system the researcher tries to recommend the nutrition base healthy food to the diabetic patient. This type of patient has many limitations for exercise and many more so diet is one of the best weapons for those who are suffering from this problem. Food Recommendation System (FRS) for diabetes patients was proposed in this study utilizing food clustering analysis. The Nutrition Division, Department of Health, Ministry of Public Health provided the dataset "Nutritive values for Thai food" for this study (Thailand). Energy, Water, Protein, Fat, Carbohydrate, Fiber, Ash, Calcium, Phosphorus, Iron, Retinol, Beta-carotene, Vitamin A,

Fig. 4 Image for the demographic based filtering method [25]

Vitamin E, Thiamine, Riboflavin, Niacin, and Vitamin C are among the eighteen nutrient values of food in a 100-g edible amount provided by the dataset. The total number of data included in this study is 290, with the majority of them being That mixed food and one-plate items [8].

Faisal Rehman in this system the researcher tries to recommend the nutrition base food to the user based on their health and the base of their pathological reports. It is difficult to select diet patterns that must meet one's nutrition needs in real-time due to the diversity of food components and the great number of dietary sources. For people suffering from numerous conditions, choosing the right diet is especially important. In this article, we discuss the importance of choosing the right diet to meet the nutritional needs of patients. The researcher designed the dataset of 345 pathological reports and the base of that this model suggests the different kinds of nutrition base food to the user. For this system 3400 food items with 26 entries for most common nutrition were taken from the official website of the composition of foods integrated dataset. For this system, the accuracy level is maintained between 80 and 100 [26].

Garima Rai and Sanjay Kumar Dubey in this review paper the author try to give the knowledge of cardiovascular patients (CVD). This paper gives the idea that how the diet can get ready for the CVD patients for that we can able to take the parameter like regular exercise, BMI & controlling the cholesterol in the body so all of them are most essential for patients but the nutrition base food is more essential for the patients so for that this review paper gives the information [27, 28].

3 Conclusion

The author reviewed all the papers identify that there is no data set available for the cardiovascular patient on the Gujarati food for Gujarat people. No researcher works on the CVD patient with the BMI factor for individual recommendation system based on nutrition. As a future scope, we can develop our dataset for the Gujarati food with its nutrients arability in the Gujarati food. In that, we also cover the fruits applied hybrid filtering for the working of CB (Content-Base), CF (Collaborative Base), DF (Demographic Base) filtering method on the data & recommend the user healthy food with their body requirement.

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Comparing Fish Finding Techniques using Satellite and Indigenous Data based on Different Machine Learning Algorithms

Zalak Thakrar and Atul Gonsai

Abstract We will look at a temperature study of fish in Indian sea water in this paper. And also, we used the survey approach to collect data from local fishermen as primary data. Satellite data is also used to provide secondary information. The effectiveness of different algorithms for machine learning in forecasting the optimal outcome of fishing data is examined in this research. We used the Linear Regression algorithm, Polynomial Regression, Random Forest, Support Vector Regression (SVR) algorithm, and Auto Regressive Integrated Moving Average (ARIMA) algorithm to analyze the data. These different machine learning algorithms are compared in this study. Multiple attributes and algorithms are evaluated in this exploratory study to find which algorithm produces the best results when these data are utilized.

Keywords Satellite · Machine learning · ARIMA · SVR · Linear regression

1 Introduction

Gujarat contains India's longest coastline, at 992 miles (1596 km), and Porbandar is home to the country's first all-weather 24-h port. The fishermen of Gujarat's seashore are well-known. Fishing is a major source of income for many locals, However, their situation gets worse every day as a result of rising marine pollution, such as chemical water from companies, which has led to a breath taking decline in fish populations. Before the advent of modern fishing technologies, fishermen had to plan their trips by hand, taking into consideration factors like the weather, tides, wind, sun, and moon. Tides and oats in the water were the main elements in this investigation. We will try that Problem-solving by combining advanced technology with traditional methods. Using the Ensemble methodology (Indigenous + scientific method), We can provide

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them with information on probable fishing areas where they can find fish. The app also showed the borders of other countries and provided the location of the PFZ on a map using a Python library to alert fishermen of the border lines via smartphone GPS.

Many sections of this article will go over in detail things like different algorithms and compare and get results using them. Then there are the data sets, such as primary and secondary data, and the research methodology used in this study. We believe that this study will demonstrate how mobility data analysis can be used to obtain insights and data that can assist fisheries operators in making better decisions. Such decisions will have significant environmental and economic consequences on a regional, national, and global scale. Our findings are preliminary, both in terms of the main and secondary data periods, we can look into the greater range of approaches that could be employed to solve this problem. Other places with high levels of fishing activity are likely to have similar data and may employ tactics similar to those discussed here.

Artificial intelligence has recently gained popularity. AI is being used by people from all walks of life to make their jobs easier. Economists, for example, use AI to profitably estimate future market prices, AI is used to help physicians decide whether a tumor is cancerous or benign, In order to make accurate weather predictions, meteorologists use AI, and HR personnel utilizes AI to scan resumes for qualifications before interviewing candidates. It is machine learning algorithms that are driving the rapid expansion of AI [1].

We go through the algorithms we used to compare performance and results in this study. These algorithms are the Linear Regression algorithm, Polynomial Regression, Random Forest, Support Vector Regression (SVR) algorithm, and Autoregressive Integrated Moving Average (ARIMA) algorithm.

1.1   Linear Regression Algorithm

In machine learning, linear regression is a popular methodology. Statistical methods are dynamic tools for analysis and prediction. Linear regression can be used for any variable that can be represented numerically (for example, sales, salary, age, or product price) [2]. Our working hypothesis for this method is that the connection between the y-axis (the dependent variable) and the x-axis (the independent variables) is linear. Linear regression is used to illustrate the effect of changing the values of the dependent and independent variables, showing a linear relationship that makes this possible. The error prediction of the 3 models we compared where the dependent variable is continuous and predictor variable is continuous and categorical. As per the result obtained from the 3 models, the result of the NNs and CART model is better than LR. Though neither of 2 models shows the clear advantage of over and other. So, There has to be more research done to establish a definitive performance gap between NNs and CART Models [3]. The lines represent the relationships between the variables in the linear regression model. As seen in the picture below (Fig. 1).

Fig. 1 Diagram for linear regression
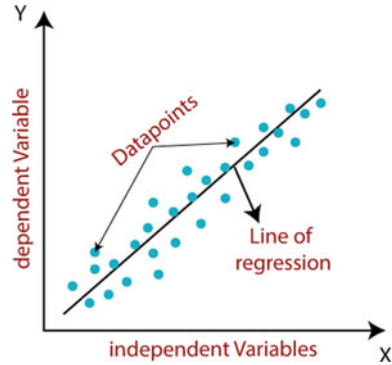
Linear regression defined numerically as the following: $y = a0 + a1x +$ [2]

Variable Dependent = Y (Variable for Target).

x shows Unrelated Variables (Predictor Variables).

a0 is the intercept of such line (gives an extra degree of freedom).

Coefficient of Linear Regression (a1) (scale factor for each input value).

E stands for Unexpected Error.

1.2 Polynomial Regression

A polynomial of degree n is used in polynomial regression to model the relationship between the dependent variable (y) and the explanatory variable (x).The polynomial regression equation is as follows.

$$Y = b_0 + b_1x_1 + b_2x_1^2 + b_2x_1^3 + ... b_nx_1^n \tag{1}$$

- Machine learning allows us to define linear regression analysis as a technique. Since we include a polynomial component in the multiple regression analysis equation, we can call the process polynomial regression.
- It's just a linear classifier with a few small improvements in accuracy.
- The regression analysis trained model is non-linear in nature, and it fits intricate and non-linear functions and datasets using a linear regression model.

Polynomial Regression is required:

We used two generally used error metrics to assess the accuracy of the transformation: Root-Mean-Square error (RMSE) for spectra and E of CIELab for human vision. The standard Macbeth plot gives an invalid result in both polynomials when tested with arctic coal. By include the training samples from the Munsell book that correlate to the arctic charr colouring, the models perform better. For the arctic charr, the spectral-based carotenoid content assessment technique used an RGB picture to approximate
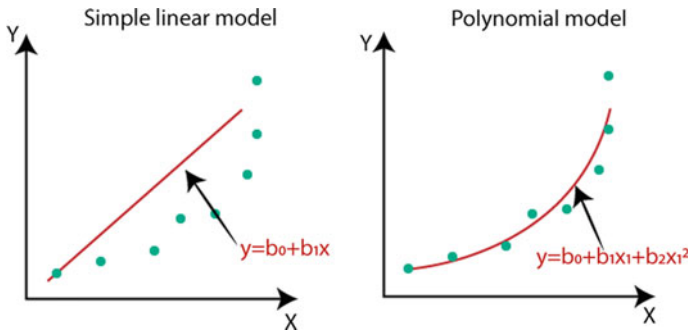
Fig. 2 Compare linear model versus polynomial model

the spectra, and the findings were crystal clear [4]. The results of this study showed that ANN models are approximately the same as other methods for predicting H' and SR. The error indices determined in the different approaches are pretty similar (MSE and RMSE). For analyses to study with an ANN model, the most relevant frequent variables for H′ and SR are conductivity, rainfall, and water temperature [5]. The importance of polynomial regression in machine learning:

- We get nice result when we apply this method but when we used the same mode to a non-liner data set without any changes.
- The Polynomial Prediction model is necessary in such cases where data points are sorted non-linearly. The following comparison diagram of linear and non-linear datasets can assist us in better understanding it (Fig. 2).

By using a data set that was organized non-linearly in the above figure we came to know what Polynomial model employs a curve to encompass the bulk of the data points and on the other hand Polynomial Regression model rather than the simple Linear Regression if the data bases are ordered non linearly.

1.3 Random Forest

The majority of the categorization and average for regression are used by Random Forest to reach a conclusion on a wide range of data. Because regression and classification are two of the most important features for identifying and describing changes, and because the Random Forest method can accommodate both types of variables, it may provide useful results and useful solutions [6].

Random forest is one of the best classifier techniques which contain number of decision trees with the different sub sets of data for predicting the accuracy of that dataset in it and on the base of that. The Random Forest collecting forecasts data from each tree and get the prediction with final result which is basically based on major votes for predictions rather than depending on the single decision tree. The
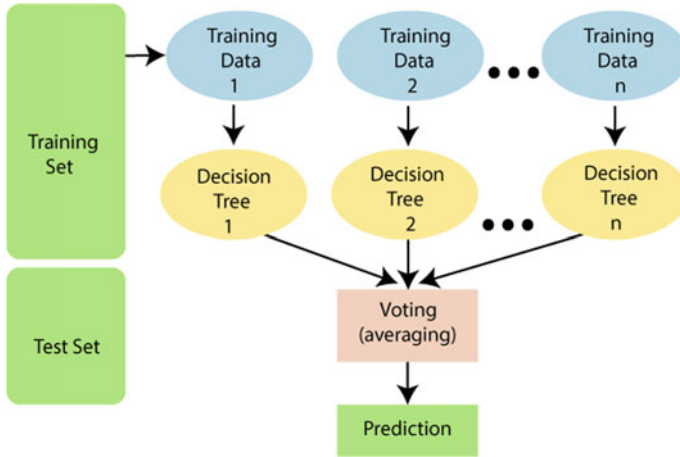
Fig. 3 Random forest algorithm

higher the accuracy and the smaller the danger of imbalanced datasets, the more trees in the forest. This can be simplifying as under (Fig. 3).

RF Assumptions:

Decision trees can successfully predict the outcomes while others cannot because Random Forest classifier combines multiple trees to get the prediction of the class for the dataset of fishing. When all the trees are merged, however, the true result is approximate. As a part of result, the two assumptions for a better RF classifier are as:

In this method we use decision trees to predict the outcome so sometime it gives accurate result and sometimes doesn't. The purpose of this study work is to categories the fish species using various methods and models. In this article, They identified 11 different types of fish and classified them accordingly. Among the 11 fish species are kettle, shingo, shrimp, rye, koi, pangas, tilapia, silver carp, carp, magur and shrimp. pH, temperature, turbidity, and fish are the aquatic characteristics they considered for the study, with temperature, pH, and turbidity serving as feature variables and fish serving as the goal variable. Machine learning models such as decision tree classifier (J48), random forest (RF), k-nearest neighbors (k-NN), and classification and regression tree are among the models employed in this work for study (CART) [7]. So here we are making two assumptions for a better RF: The feature variables in the dataset must have some appropriate and realistic values so that the classifier can able to predict the perfect results instead of making assumption.

1.4 Support-Vector-Machines (SVM)

For regression and classification, SVM is a very useful machine learning thing now a day. The line equation in support vector regression is y = wx + b, which is quite close to the linear regression line equation. In SVR, this straight line is known as the hyper plane so when the points closest to the boundary line in the fishing dataset on each side of the hyper plane serve as support vectors. Instead of shorten the difference between the actual and predicted values, SVR attempt to fit the optimal line within a threshold value. So as a Conclusion the SVR model attempts to fulfil the −a y−wx + b a constraint, as a final analysis. Using locations along this range, it gives the predicted the value for the data [8]. SVM used various techniques to classify the data of the various areas. This review paper shows the SVM and its applications potential in the oceanography research. So that in future, oceanographer can use SVM for the ocean data analysis in different ways at very fast with high accuracy [9]. The accuracy of the predictions is improved in a second step using the Moth Flame Optimization MFO SVM hybrid system. In contrast to other machine learning algorithms, the recommended strategy is presented first. As a consequence, the suggested technique achieves higher sensitivity, accuracy and specificity, reaching 98.7%, 97.90% and 99.99%, respectively, with a standard deviation of 0.017 [10] (Fig. 4).

To accomplish the linear separation in this non-linear regression, the kernel function first transforms the data to a higher dimensional representation. Over here we will use RBF kernel and then utilize SVM in this example to estimate a student's grades based on the number of hours spent studying [11].

Fig. 4 Support vector machine (SVM)
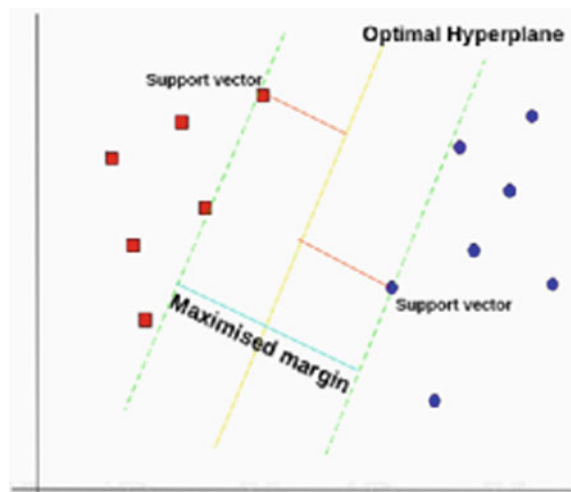
1.5 Auto Regressive Integrated Moving Average (ARIMA)

Time series data can be determined using the ARIMA model, which is used to analyze data and predict future events. Using historical information, this method is widely used to make future predictions. If a company wants to predict future profits based on historical data, it can use the ARIMA model [12].

- Future values are estimated using models like the autoregressive integrated moving average (ARIMA).
- ARIMA uses lag moving averages to horizontal time series data.
- This method is recently used in scientific analysis to predict stock prices in the future.
- Autoregressive models forecast a same future to the past.
- In some market situations, such as economic downturns or rapid advances in science, they may turn out to be wrong.

A regression study called the Auto Regressive Integrated Moving Average model determines how strong a dependent variable is with respect to other changing variables. The purpose of the model is to predict the price of securities in the future based on the trend of the data series (not the absolute value). The following is an explanation of each character for the ARIMA-model:

Auto-regression (AR): Auto regression is the model which shows a variation in the variable dependent on previous or lagging values.

Integrated (I): In order for the time series to become stable, raw observations must be separated.

Moving-Average (MA): The link between a data point and its associated remaining error which is taken into account by a moving average model applying to the interval observations.

ARIMA Factors:

Each character in ARIMA is behave as a parameter with a consistent name. The typical nomenclature for ARIMA models is ARIMA with p, d, and q, whereas numeric values are replaced by the parameters to affect this kind of ARIMA model used. The following are the factors:

- p: Interval sequence of the model, the interval is sometimes considered as the number of observations
- d: how usually the number of raw observations varies which is also known as degrees of convolution.
- q: Moving Average Window Size, often referred to as a Moving Average Order.

2 Datasets

A data set is a representation of an item's height, weight, temperature, volume, and other characteristics, as well as random values. A data set is a collection of data points. For each row, the table of contents includes information from one or more members.

2.1 *Types of Data*

In this study, there are two kinds of data, first which calls main data and second which calls secondary or binary data. In my research, I look at both types of data with keen interest.

Primary Data.

I made primary data by doing Surveys, personal or face to face visit, and experiments are examples of data collected by researchers with the goal of assisting them in comprehending and addressing the research topic at hand.

For this study, I used a questionnaire to collect primary data. I made Google Forms which is highly used to collect data in the mode of questionnaires. In the questionnaire, I included variables such as weather changes, short-term sea storms, data on fish identified in various seasons, fish breeding season, water parameters etc. Data is collected using time factor like low and high tides, sunset and dawn, directions, and many others.

Secondary Data.

I gathered secondary data by reading Newspapers, personal sources, websites, journals, Gujarat fisheries department publications, from Gujarat Maritime Board and Gujarat fisheries department Annual Statistical Books are examples of secondary data sources for my research. Primary data is known to be more difficult to come by than secondary data. For my research, I used satellite data to determine chlorophyll and SST (Sea Surface Temperature) and Water Temperature.

To add scientific manner to my research, scientific indicators collected from the satellite's Ocean Color website (MODIS-Aqua and MODIS-Terra Sensor) which give (Ocean Surface Temperature (SST), chlorophyll content), and other parameters, we may use machine learning to advise fishermen about fishing areas.

3 Research Methodology

To make effective research we much do data pre-processing which is very useful in any research. Following the collection of data using different ways which can

be sectioned like the primary responsibility is to analyze the data using various technologies. In this study, I used the Scikit-learn (Sklearn) library tool for data analysis to identified a variety of mathematical outcomes.

3.1 Scikit-Learn (Sklearn) Tool

When it comes to Python machine learning libraries, Scikit-learn (Sklearn) is one of the best. It provides many sets of effective data for machine learning and statistical modeling capabilities like work of classification, work of regression, work of clustering & dimensionality reduction through the use of Python interface. This Python-based toolbox mostly relies on the library like NumPy, SciPy and Matplotlib and may mor. [13].

Scikit-learn's components include:

- **Supervised machine learning algorithm**: Scikit-learn provides practically every well-known machine learning method for perforating linear regression models to SVM, Decision Algorithm Trees, the scikit-learn tool has it all. The abundance of machine learning methods available for testing statistical models increases scikit's popularity. I started working with scikit to address large supervised learning.
- **Cross Validation**: There are many methods for checking the accuracy of supervised models with unknown data using Sklearn.
- **Unsupervised learning**: Some examples of machine learning techniques that may be used for unsupervised learning include clustering, factor analysis, principal component analysis, and unsupervised neural networks..
- **Different datasets**: This thing was come into my glance when I was studying scikit. Utilizing a large number of academic datasets which helped me to understand SAS for example, IRIS dataset, Boston House prices dataset etc.

3.2 Data

Machine learning and artificial intelligence (AI) are primarily separated into 2 groups: The first is supervised learning, whereas the second is unsupervised learning. The main difference between these that one uses tagged data for prediction while the other does not. There are some vital differences between the two methods, as well as places where one is superior to the other. This document will explain the differentiations so that you can determine which technique is best for you.

Supervised learning:

Supervised learning is a kind of machine learning that operates on labelled datasets. These data sets are used to "train and test" algorithms to efficiently select data and predict results for predicting SST and CHL. The model may be checked for accuracy

and trained with continued use labelled the inputs and the outcomes. Classification and regression are the two types of supervised learning used in data mining [8].

- **Classification**: This method managed to classify the test results into different groups, like the classification of fish. Spam may be classified and isolated from your email using supervised learning algorithms in the real world. Linear classifiers, support vector machines, decision trees, and random forests are examples of classification methods.
- **Regression**: Regression is second type of supervised learning technique. It involves using an algorithm to test the relationship between dependent and independent variables. Regression models are helpful for estimating numerical values based on several data points, for as predicting the price of fish. Three of the most often used regression algorithms in the world are linear regression, logistic regression, and polynomial regression.

Unsupervised learning.

Machine learning algorithms are used to analyze unlabeled data sets and aggregate them in unsupervised learning. Without the help of humans, it is not possible to identity hidden patterns (so the term "unsupervised"). Unsupervised learning methods are very friendly to do tasks like as clustering, association, and dimensionality reduction [14].

- **Clustering**: Clusters is one of the best data mining techniques to classify unlabeled data into groups based on their equalities and variations. Let's see an example for it; Similar data points are basically aggregated using K-means clustering, where the number K represents the cluster size and level. Market analysis, picture compression, and other applications benefit from this technology.
- **Association**: Another unsupervised learning technique that can be used to develop rules for determining relationships between variables in a data set is correlation. These methods have recently been used in market curve analysis and recommendation engines, such as "Small Fish or Large Fish for Export Catalogers"
- **Dimensionality reduction**: Dimensionality reduction is a particularly useful learning method for users when a dataset contains a large number of real features. It preserves data integrity while limiting the amount of data inputs to a manageable level. When auto encoders eliminate visual noise from visual input to Boost picture quality, this technique is commonly used in data processing stage.

4   Result

In this work, we gathered data in two different techniques. The core data set was a Google form, and it was discovered that fisherman fish while considering several

criteria. We gathered over 200,000 temperature and chlorophyll data from the satellite server (https://oceancolor.gsfc.nasa.gov/) online during the previous 10 years as secondary data. Using the machine learning tool SK learn (Stat tool), various results have been produced. In this case, the accuracy result based on linear regression is 71.12%. Polynomial regression yielded a 72% outcome. Polynomial regression at level 10 yielded a 72.16% result. The random forest result is 42%. The AR and ARIMA machines produced 48% of the results, while the SVR (Support vector Regression) machine produced 82%.

5 Conclusions

In this study, Scientific and indigenous data were used in the development of this research, which attempted to create automated systems for detecting prospective fishing behaviour in various kinds of gear. We devised a strategy for each form of fishing based on the particular problems posed by the systematic variations in fish behaviour, wind speed, wind direction, and fishing duration for each type of gear. More than half of the potential fishing events (42–81%) were properly identified by our machine learning and data mining algorithms, compared to the labelled data. It is important to note that our algorithms worked equally well for diverse fleets in different locations working on regional to global dimensions, making this a flexible tool for studying the behaviour of fishing fleets globally. We know of only two previous studies that used satellite or water data to identify and classify fishing, and these studies serve as an important basis for the work described here, but no previous research has focused on a complete approach to global identification and classification of fish stocks using gear type discrimination. This is the first time that we have seen this type of comprehensive approach to the problem. In order to identify prospective fishing activities for fishermen, we presented three separate algorithms based on machine learning, data mining, and filtering. Aside from that, we're also working on developing an Android app for fisherman to use while out on the water. Small and handmade fishing boats, which are now mostly undetectable in most monitoring systems, provide a significant difficulty for behaviour detection. Fishery effort intensity and distribution in diverse locations, Including the country's exclusive economic zone, the high seas and places of special importance, such as marine protected areas and other areas of biological or administrative importance, will be obtained by analysing long-term monitoring data.

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Implementation of E-Governance Framework for Rural Areas of India

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Abstract India is a large country with a large population. The rural population of India is a significant aspect of Indian society and reflects actual India. People of this rural populace have to face many issues to get any kind of information about government schemes and due to lack of information; they cannot get benefits from those schemes. This study will help them to complete this procedure at the tip of their finger on their mobile phones or computer and save their precious time and cost. This research mainly focuses on rural areas such as "Gram-Panchayat" which is located on the West Bank of Gujarat state, Porbandar district. In this research, the researcher mainly emphasizes two types of data those are primary and secondary as a part of the research methodology. Both the Reliability and Hypothesis tests significantly apply to primary data. This will lead to a better e-governance framework.

Keywords E-governance · E-services · Framework · Common service centre · Rural development

1 Introduction

E-governance means reaching out to the public through online services. This can save the money and time of both the government and the public, and you do not have to turn around about the various offices again [1]. E-governance means reaching out to the public through online services. This can save the money and time of both the government and the public, and you do not have to turn around about the various offices again. The government has taken many steps in the last year to improve its online services, such as online payment, bill collection, providing information to its branches via the internet and receiving responses, and multiple online exam forms for

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government jobs, but we have yet to reach out to rural areas for all of these services. When we talk about the usage of advanced technology of computer-based services in rural areas, most of the villages are dependent on nearby cities, not only those villagers but also government officers depend on it. Via this application, people of rural areas do not need to be dependent on nearby cities for the multiple services of the government to complete their work. We are trying to implement this application, which will help Gram Panchayat to get all the information regarding schemes of government, information regarding nearby Gram Panchayat of other villages as well as their village. The main objective of this application is to give better citizen services to the villagers through the computerization of the application. Digitization is not just for urban areas or metropolitan references but it should be beneficial for rural areas also [2]. The Government of India has implemented e-Governance gradually everywhere. Because of this, most of the work can be easily availed by the citizens of the country by saving their time [3]. This application will help every Gram Panchayat in India to become digital by providing an E-governance service [4].

This paper is divided into several sections or key themes. The first section discusses the common service center. In this section, I cover the CSC, as well as the CSC scheme 2021. Define the E-governance projects list in India's rural areas in the next section. In the next section, I will go over the results of a literature review on e-governance frameworks and services. Then, talk about research methodologies, such as the research area, methods, and data collection. Then define analysis and interpretation, such as the non-parametric chi-square test that I utilized in my study. Following that, I define the study's results and discussion, and finally, I conclude the study.

2 Common Service Centres

In the areas of e-governance, education, health, telemedicine, entertainment, and other private services, the CSCs will provide high-quality and cost-effective video, voice, and data content and services. The CSCs will provide web-enabled e-governance services in rural areas, including application forms, certificates, and utility payments such as electricity, telephone, and water bills, among other things" [5]. "Apna-CSC: The Common Service Centre (CSC) is a part of the Indian government's National E-Governance Plan Scheme (www.csc.gov.in). The Common Service Centre scheme is in place in all of the country's municipalities" [6] (Table 1).

Table 1 Apna CSC scheme 2021

Scheme name	Scheme of common service centre (CSC)
Article category	Information of Apna CSC, digital Seva Kendra
Responsible authority	Ministry of Electronics and Information Technology (MeitY)
Area served	Rural India
Approved in	2006
Formulated by	Government of India
Registration mode	Online
Website address	www.csc.gov.in

3 Literature Survey

Table 2 describes the insights and limitations of projects developed for rural areas in a literature survey. This study looked at several publications from journals, conference presentations, scientific articles, and Ph.D. theses from numerous universities.

4 Existing Work at Gram-Panchayat Level

At the village level, the Common Service Center is a primary center. These centers will be present at the neighborhood level, with an officer in charge of a computer connected to the Internet and running our program. Citizens are the only ones that can apply for this CSC. We cannot expect a continuous internet link at this CSC, i.e. at the village level, so we will have a local database that will store all of the citizen applications. "It will apply to the Authority Center located at a distance as soon as the internet connection is open or at the end of the day".

The user will apply for the service at CSC (Shown in Table 1), which will then approve the application form and required documentation from the user and forward them to the Authority Center. The Authority Center will review and process the applications and documentation as required. "The Authority will now determine whether to accept or refuse the plan. The CSC will obtain the result, and the user will notify the CSC of the status of his submission. As a result, the customer will only be able to access the services via CSC" [22]. Any part of the village requires the presence of the CSC. We recognize that this is a challenging task in a nation like India, where 70% of the population lives in rural. Even though many dangers can harm us, we are courageous enough to face them.

Table 2 Literature survey

References	Insights and limitations
Kumarwad and Kumbhar [7]	This study aims to lay the groundwork for the development of an e-governance framework. According to the researcher, most e-governance initiatives have similar aims, priorities, and visions, but the implementation method differs. To address these issues, all states must share a shared vision, priorities, and targets, as well as a common solution framework **Limitations**: The services provided to people are not specified in this report. Furthermore, the introduction of essential needs or basic services for rural residents was limited in this report
Harekrishna Misra [8]	Via an established conceptual structure, this article aims to explain the basic problems and opportunities faced when channeling E-Government services available in rural areas. The goal of this work is to evaluate both convergence and rural E-Government services affect long-term growth **Limitations**: This study was limited to residents' involvement in these facilities. Researchers must have better services so that the amount of satisfaction between the government and residents rises
Sangole and Bhura [9]	This system was created with the needs of a Grampanchayat records administrator in mind, and it allows the administrator to make database entries about Villagers, individual details, taxes, and certificates. He also can control his account according to this device **Limitations**: They will add a lot more functionality to the system in the future, such as an alarm system, notifications from the Grampanchayat to the Gramsabha, and a transaction system that handles all of the money-related work. They only worked on government schemes in this application, not on any other services for rural citizens
Sagar and Shilpa [10]	In this study, rural people may view for service and receive updates on the status of their application, such as acceptance or rejection, by using this software on their mobile device. This software is also beneficial to gram panchayat staff and officers, who can use it to view applications, update facilities, and check the status of applications **Limitations**: The people of the village can look at various government schemes and services because of this report. However, there is less mention of village-level facilities. The ability of the villagers to establish their own business is not shown as a service in this study
Dhage et al. [11]	This project aims to create an E-Gram Panchayat Management System (EGPMS). EGPMS is a web-based technology that can be operated from anywhere in the world. This system can be used to monitor the activities of gram panchayats **Limitations**: People in this research were not given their login. Any individual can enter the data and retrieve some information from the archive, but only members of the body have permission to upload it

Table 2 (continued)

References	Insights and limitations
Jain et al. [12]	This study lists the latest I.C.T. efforts of the federal and state governments, as well as the obstacles that local self-government faces in reaching technical maturity in this global age of digitization **Limitations**: The most difficult task for good governance is to create an ethos that emphasizes consistent and successful commitment over infrequent involvement
Salihi et al. [13]	The study analyzed each country's level of accomplishment based on points assigned. The study also ranks Middle Eastern countries according to their level of e-government growth, using manual and automated testing to assess if a particular requirement was met **Limitations**: In languages like Arabic or Hebrew, there are few online links on web accessibility
Dhage et al. [14]	This system can be used to monitor the activities of gram panchayats. Admin and body members can log in, and the public can browse the details given about the gram panchayat at any time **Limitations**: For the gramsevak and admin, this system provides a user ID and password. Villagers may only access details and download documents
Kumarwad et al. [15]	The Common Service Centre project is used in this research paper to investigate the current condition of the e-governance project in the Satara district of Maharashtra, India. In addition, the study examines e-services and their activities in the Satara district during the 2016–17 academic years **Limitations**: In comparison to the number of people in the Satara district, the number of active CSCs is extremely low. It is critical to support CSC VLEs that provide services in rural and remote areas
Jange and Chittaranjan [16]	The authors of this study evaluate the current literature on rural librarianship and highlight some smart village projects and Indian government programs aimed at providing information to rural communities **Limitations**: There is still more to be done, and rural librarians must hone their abilities and create a passion for rural empowerment through information distribution and public access
Sawane et al. [17]	They created software and an Android framework for this purpose. Its key goal is to find out who wants documents from the gram panchayat. They will apply both online and with an Android app **Limitations**: They created the software mostly for farmers. Other villagers in the village will be less able to profit from this software

Table 2 (continued)

References	Insights and limitations
Shelar et al. [18]	This project aims to create an E-Gram Panchayat Management System (EGPMS). EGPMS is a web-based technology that can be downloaded from anywhere in the world. This system can be used to monitor the activities of gram panchayats **Limitations**: The framework is not designed to provide villagers with a means of earning a living or to provide emergency medical care for their survival
Sahu et al. [19]	This project's major goal is to deliver government services digitally. The public can access this online service to view a list of government services on their mobile device, learn more about call register documents, and apply for services online **Limitations**: This system does not enable communication between users and gram-panchayat Talati Mantri. Additionally not allow people to use this framework to build their businesses
Amutha [20]	This article focuses on the challenges and potential of e-governance as a tool for rural development in India, with a special focus on information technology (IT) **Limitations**: In this study, the role of e-Governance in Rural Development is to find out the E-Governance Initiatives for Development of Rural India and only to analyze the Issues and Challenges of E-Governance
Ilyina and Anastasiya [21]	In this instance, e-governance system enhancement in the service delivery process of public bodies is necessary for the growth of human capital. It would enable ongoing contact between local self-government organizations and public agencies **Limitations**: The government's e-readiness is low in this assessment, which solely compares Ukraine and Estonia. With the approval and implementation of new e-governance laws and regulations

5 Research-Methodology

5.1 The Research Area

The choice of Porbandar's gram-panchayats of Gujarat states for this study was influenced by a variety of government services, but the difficulty is that all of these facilities are related to VCE. People in these locations are unable to obtain information on their own. They must visit the CSC center to obtain information about any schemes or information about such schemes. Porbandar is located at 21.63° North Latitude and 69.6° East Longitude on the globe. Gujarat's port city, situated along the Arabian Sea's coast, boasts a strategic location. Porbandar is still an important port that connects India to many other nations [23]. Porbandar district has three talukas (Porbandar, Ranavav, and Kutiyana), however, I chose just the Porbandar taluka from

Gujarat's Porbandar district for my research. Porbandar is a town and taluka in the Gujarat state of India's Porbandar district. In this Taluka, there are 75 villages in total. According to the 2011 census, the Taluka of Porbandar has a total population of 185,191 people, with 94,807 men and 90,384 women. In Porbandar, 16,834 people work as agricultural laborers, including 11,074 males and 5760 women [24].

5.2 Methods

To fulfill the research aims, the study used a descriptive research design. To collect qualitative and quantitative data for the study, a semi-structured questionnaire was created. Before the actual survey, the questionnaire was pre-tested, adjusted, and deployed in a randomly selected gram-panchayat and government region.

Sampling and sample size

The sample frame for the study, which consisted of 167,457 rural households, was created using crucial information. This study used data from 74 g-panchayats in Porbandar taluka. The study's respondents were chosen using the snowball sampling approach. This data has been obtained from different villages of Porbandar district taluka. This data has been taken from different respondents such as VCE, Talati cum Mantri, sarpanch, villagers, etc. I also checked the sample size using an error of margin 5 and a 95% confidence level of data.

5.3 Types of Data Collections

Primary data

The primary data for the study came from 1200 people living in rural villages in Gujarat's Porbandar district. The primary data was collected from 1200 rural residents in the Porbandar district. The questionnaire has been sent to rural respondents who were chosen at random. SPSS (Statistical Package for Social Science Research) is the program that the researchers used to analyze the data they gathered.

Secondary data

Secondary data is gathered from a variety of sources, including books, magazines, newspapers, village Sarpanches, village VCEs, village Talati Cum Mantri, and district panchayats. In terms of application architecture, I would like to use the PHP platform to create a new application built on an E-Government system with a user login ID.

6   Analysis and Interpretation

Analysis of data collected via a questionnaire from Gram Panchayat villagers in Porbandar district. This research focuses on a descriptive and inferential statistical analysis of data collected from Taluka in Gujarat's Porbandar district. A total of 1200 people from the Taluka of Porbandar District were sampled. When the dependent variable is assessed at a nominal level, the Chi-square statistic is a non-parametric (distribution-free) tool for analyzing group differences. So Chi-square statistic was used to examine the data.

6.1   Non Parametric Tests

Chi-Square Test Formula

$$\chi^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} \tag{1}$$

where O = Observed value
    E = Expected value [25].

6.2   Hypothesis

In communication research, a hypothesis is used to explain phenomena or anticipate a relationship. A hypothesis must fulfill four assessment criteria to be considered valid. For this study examined 12 variables from the questionnaire. these variables are Gender, Age, Educational, Qualification, students, Business, using the internet, using devices using the internet, using online services, using e-governance website, facing any problem in getting government services, satisfaction with the manual system, VCE helped in getting e-governance services.

6.3   Reliability Test

Cronbach's alpha provides the appropriate metric for evaluating the reliability of the evaluation parameters of the study. The benchmark limit for Cronbach's alpha coefficient is 0.70, by which values higher than this benchmark are acceptable. In the present study, the values of the coefficients are 0.594.

Cronbach's Alpha Formula

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N - 1) \cdot \bar{c}} \tag{2}$$

where

- N = " No of items available"
- $\bar{c}$ = "Average Covariance between item-pairs"
- $\bar{v}$ = "Average Variance".

7 Results and Discussion

7.1 Proposed Framework at Gram-Panchayat Level

There are four users in the proposed system, Villagers in rural areas, the VCE, the Talati cum Mantri (Government officer), and the Taluka administration. Rural people get all of the information they need about government schemes, as well as information about nearby Gram Panchayats and their villages. They can also view or apply services provided by Taluka admin. VCE (Village Computer Entrepreneur) is the second user, and he or she can upload files related to government services, handle village notifications, and access or request services. Talati Mantri and Taluka Admin are in charge of both services and village information.

The proposed framework provides Information about Gram-Panchayat to the villagers in Porbandar, Gujarat. Admin is required to login into the website and they can modify the Schemes and information about the website & can manage the users of the respective framework. The client can easily view the information, Schemes & Services that are available in gram-panchayat and can complain about their respective problems using this framework.

7.2 Users of the Proposed Framework

Admin

- Admin is the main person in the system that handles the whole framework.
- Admin can log in to the framework.
- Admin can manage a homepage.
- Admin can also manage Services and offers related to the gram-panchayat.
- Admin can approve the client.
- Admin can have authority to manage and add Services.

User

- Users can see Services, Schemes.
- Users can view Information, special offers, etc. provided by the government.
- The user gives feedback on the site.
- Users can log in to the site.
- Users can take part in the respective schemes as per their requirements.

VCE

- VCE uploads the information.
- VCE operates the work related to computers.
- VCE Upload files and data to the website
- VCE manages notifications related to gram panchayat.

Talati cum Mantri

- Talati cum Mantri approves the data uploaded by the VCE.
- Talati cum Mantri approves the details and data of the website.
- Talati cum Mantri gives responses to the respective complaints of the villagers.

8 Conclusions

According to the findings of this study, the technologies used by rural residents of the Porbandar district to improve their lives could become a new e-governance framework. The study also found that the new e-governance framework could play a significant role in improving the socio-economic status of the people. With the help of this framework, the people of the village can get information about any scheme of the government sitting at home, they can log in to this framework and avail the benefits of new services, and any village-related complaint could be made to the village Talati. To address the fundamental requirements of the common person, make all government services available in his area through common service delivery networks, assuring quality, accountability, and dependability at affordable rates. The rural society and the administrative body will be better able to work together under this new arrangement. The new web-based architecture will offer an efficient solution for developing an E-Government environment in which the majority of the work can be done online, according to the research and analysis findings. This would aim to reduce corruption in the system while also saving the common person and government officials' time and money.

The finding of the study has developed a system to meet the current challenges faced by people living in rural areas. The following are the main finding of this study:

- To design and developed a new e-governance-based system to facilitate between citizens and government.
- To design and develop applications based on internet user increase in Rural Areas (Gram-panchayat).

- In the new system, I provide some new services, which will be very beneficial to all villagers.
- Villagers will get all information about Gram-panchayat on their phones or tablets.
- Under this initiative, users can log in and access new services.
- Under this initiative, VCE and Talati cum Mantri can upload government-related information and user can see it.

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Opinion Summarization from Online Mobile Phone Reviews Using Feature Based Association Rule Mining

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Abstract In the modern period, sentiment analysis and opinion mining are expanding greatly. On the internet, there are numerous e-commerce sites where customers can leave evaluations for a specific item. The reviews filled by the users are of most interest to both the individual, who is interested by the same product as well as the business person who wants to upgrade their product based on client's review. We might be able to extract opinions from the internet and forecast customer preferences if we had a reliable mechanism for forecasting sentiments. Sometimes only knowing about the polarity related to specific product or service is not sufficient, summarized representation of these opinions is also very important to know about opinion related to specific feature of the product. There are various representations available for opinion summarization. Feature extraction is very crucial step in opinion summarization because based on extracted features summary can be generated. Three levels of granularity exist in opinion mining: document level, sentence level, and aspect level. ARM is used to find features of product and then naive bayes algorithm is applied to find polarity of the reviews. And at the end, whole summary is generated from review dataset. In this paper association rule mining is used to extract the features from online reviews of mobile phone.

Keywords Sentiment analysis · Opinion mining · ARM · Naïve Bayes

1 Introduction

The computational analysis of people's attitudes, views, and feelings toward an object is known as sentiment analysis (SA) or opinion mining (OM) [1, 2]. One may say that with the aid of opinion mining, a miner can comprehend and obtain an understanding

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of both the positive and negative aspects of any good or subject. The advantage of getting these reviews is, when system wants to recommend something to users then it can be done only with the help of highly scored positive opinions from large number of users. Opinion mining is used by large businesses and businesspeople to advance marketing [2, 3].

A lot of research is already done on analyzing the sentiments of users based on their reviews. In these studies, SA or OM is taken into consideration at one of the three levels: the document level, sentence level, or attribute level. In the context of sentiment analysis, the research that is done so far indicates that 2 techniques are very important: (1) Machine Learning and (2) semantic orientation [1]. These techniques are represented with the help of diagram in Fig. 1.

If we consider reviews from the users, then it has a lot of challenges in terms of polarity of the particular review. It may be possible that some opinion words may look positive in some specific context but the same word may be used negatively in some other context/situation. One more issue while targeting people's opinion is that, everyone is not having same expressions or words for showing their opinion. So broadly it is believed that if there are less differences between two pieces of text then it does not change the meaning. In Sentiment analysis, however, "the picture was great" is very different from "the picture was not great". People can have 2 different types of reviews in the same statement [2, 3]. A lot of reviews are having both the types of comments (negative as well as positive) in the same statement which can be focused by deciding the polarity by focusing on a single statement at one time.

Users usually show or represent their views towards any service or any product that they have used or purchased respectively. They do write their reviews or opinions in shopping sites, blog posts or any site that welcomes reviews from the users. These reviews are not just useful for the other users but also for the people who are manufacturing the product as well as those who are creating the services for other users. Many times it also happens that people do not understand the context in which the other person has written the review.

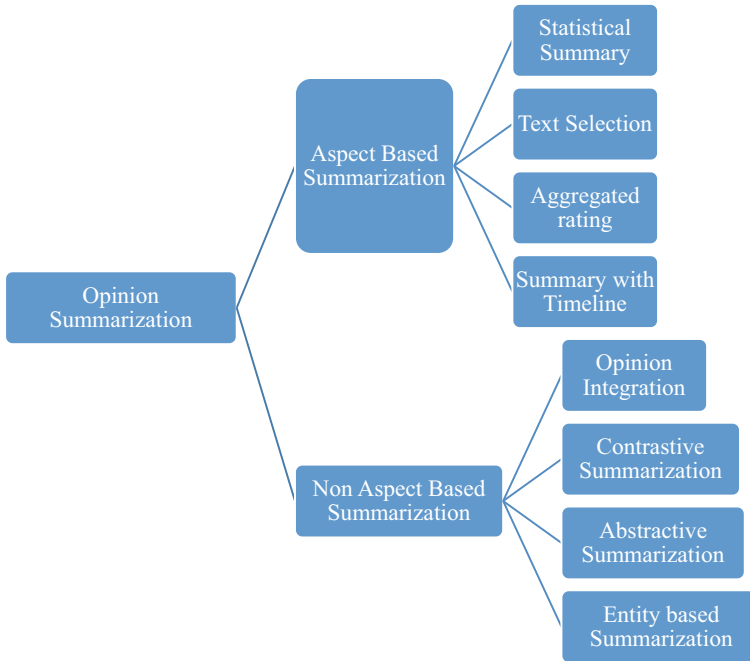**Fig. 1** A broad category of opinion mining techniques
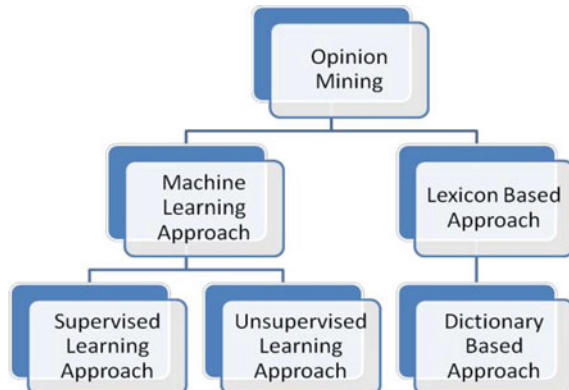
Fig. 2 Opinion summarization methods

- Aspects that are explicitly mentioned as nouns or noun phrases in a sentence are called as **explicit aspects** [2].
- **Implicit aspects** are not explicitly mentioned in a sentence but are implied [2].

Opinion summarization contains various algorithms based on categories of opinion summarization. Figure 2 shows basic categories of opinion summarization. Opinion summarization can be at document level, sentence level or aspect/feature level.

The remaining part of the paper is managed in the following way. Section 2 focuses on the overview of similar work done in the same field. Section 3 contains proposed problem definition. Section 4 contains proposed methodology and technique used in the system. Section 5 contains experimental results. Section 6 contains conclusion and future work.

2 Related Work

In [4] graph based approach is used for showing opinion. Each node in the graph contains review by user and by calculating polarity of opinion, if neighbour node contains same polarity then aggregation is performed. Based on type of aggregation

(horizontal or vertical) rules of aggregation are applied. Parsing is performed on forum posts dataset by standford parser. After that feature extraction is carried out. From these extracted features, filtering is performed to extract opinion words for opinion orientation identification. Then nodes that do not contain any opinion are discarded from graph and at the end aggregation of nodes containing same polarity of opinions is carried out.

In [5] technique for summarizing web reviews as document summarization problem is proposed. Ranks are given to sentences of the documents for summarization purpose. Sentences with low ranked reviews are discarded while generating summary. By combining existing summarization method with rank information summary related to product becomes more informative.

In [6] automatic mining on trending topics of twitter is done to generate summary. These extracted topics are compared with news articles to find its relevance. The main feature of this method is that it refines the trending topics to make it mutually exclusive. Sentiment analysis is carried out on tweets to find mass reaction and after that short summary is generated from extracted tweets. This method has good accuracy in summarizing trends.

The paper [7] contains novel feature level review summarization method to visualize mined features with associated opinions and polarity. In first step subjectivity and objectivity classification of review is generated with the use of supervised machine learning technique which prevents noisy and irrelevant reviews. After this rule based approach for feature-opinion pair extraction is used. Summarization method is applied on these pairs. Summary is shown with review list, its description and review result. Bar and pie charts can be used as visualization purpose.

Paper [8] uses statistical model for opinion summarization. The entire system is made up of 3 main modules: Text extraction, sentence extraction and summarization. In this method parser is applied to blog documents to extract text from document. On this extracted text, opinion extraction algorithm is applied with the use of sentiment Wordlist to decide polarity of sentences. The output of extracted opinion with the sentences used to decide the polarity is used check against word limit of summary. If word limit is not exceeded, then summary remains as it is and if it is exceeded then summary extraction algorithm is applied to these extracted opinion sentences to get final summary within word limit.

In [9] Latent semantic analysis (LSA) technique is used for text summarization and evaluation of summarizes text. LSA based two new summary evaluation parameters are introduced to know the quality of summary based on its length. Based on experiments it is proved that LSA is sensitive on stop list and lemmatization process so working on improved version of lemmatizers is necessary.

Informative sentence selection for opinion summarization is proposed in [10]. In this paper, aspect coverage and view point coverage are used as evaluation parameters. Sentence graph is generated with the use of amazone dataset. Leaders and communities are found from this graph with use of community leader detection algorithm. Various product comments are summarized with this methods to know about accuracy of the algorithm.

Feature based opinions are considered and summarization of those opinions are done in [11]. The author has shown unique technique is find features from reviews written in Arabic language. NLP tools were used to find the important features from the reviews.

3   Problem Definition

User reviews are very important for knowing polarity of users regarding product. Summarization of generated reviews is also important for users to know other People's view about aspects. Extraction of features is very crucial phase for summarization. ARM can reduce number of features and considers only relevant features. From this, proposed definition is "Opinion Summarization from Online Mobile Phone Reviews using Feature based Association Rule Mining".

4   Proposed System

Review database used as an input to the system. As reviews are unstructured text, pre-processing is applied on this review dataset.

4.1   Preprocessing

Amazon dataset was used to do all the tasks.
Three Preprocessing steps applied over here are described as follows:

- Remove Stop Words, so that text database will no longer contain words like the, a, an etc.
- Stemming is used to convert each word of review to its root word. For example, words like Purifying, purity, purified, purest are converted to its root word "Pure". For this purpose Porter Stemmer Algorithm is used.
- Pos Tagger is applied to tag words with its part of speech. StanFord POS Tagger is used for this purpose.

4.2   Extract Frequent Aspects Using ARM

The proposed method introduces different association rules for POS Tagged output. By doing this, combination of words is taken as feature which is more beneficial for summary generation.
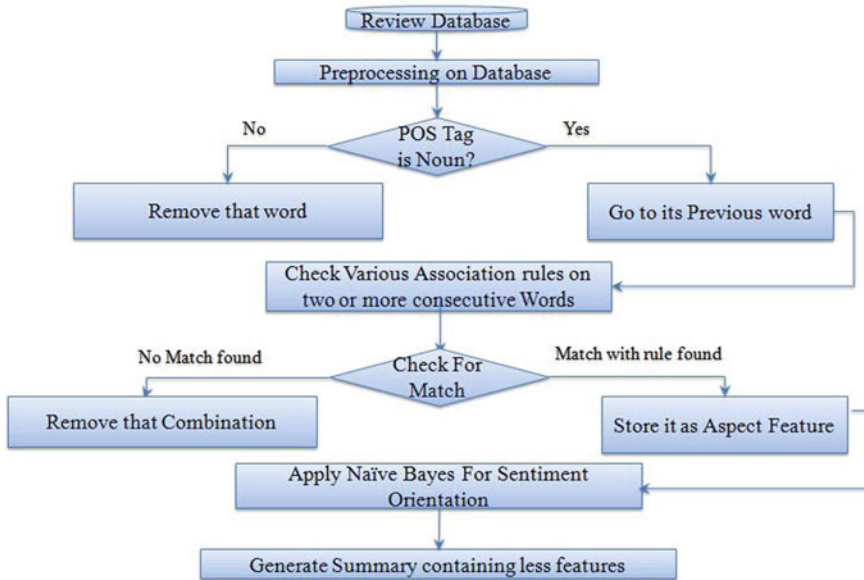
Fig. 3 Proposed workflow

For every review in dataset, tag of words is checked. If tag of word is noun, noun phrase or nouns then tag of previous word of these selected words are checked. And if tags are noun, noun phrase or nouns then the whole combination is considered as single feature by concatenating two words.

To prune features for finding only small number of relevant features different combination of pos tagged words is checked. These combinations can be:

- Adjective, Noun,
- Determiner, Noun, Noun,
- Determiner, Noun, Noun, Preposition,
- Determiner, Adjective, Noun, Personal pronoun,
- Preposition, Noun Phrase, Noun etc. (Fig. 3).

All these combinations are checked to find features. Adjective and noun combination provides good list of features which help in generating good summary about any product. Thus we get small set of features than that we get from existing method.

4.3 Opinion Orientation

Naïve Bayes algorithm is used for Sentiment Orientation. Steps of Naïve Bayes: 3 different Text files are created

- Positive words,
- Negative words and
- Review sentences are used.

After that, combination of two consecutive words were compared against these 3 files and then single word was compared against the same.

- If the same word is found in the word list then rule related to the opinion word is applied.
- If word that is found matches to the negation word then negation rule is applied.

Opinion Word Rule:

Rule that is created here is very simple:

If the word that we found matches with any one word from positive word list then positive opinion count will be increased by one every time. And same for the negative word.

Negation Rules:

- If previous word of negative opinion word is negative, then positive count is increased.
- If previous word of positive opinion word is negative, then negative count is increased.

4.4 Get Summarized Review

At the end summary is generated which contains total number of positive and negative sentences with orientation of features in review dataset. The summary, thus generated provides good results which is discussed in following section.

5 Experimental Results

To calculate accuracy of proposed method and to compare it with existing work following parameters are used:

Precision

Precision shows exactness. It is the measure of reviews that are correctly classified or relevant from total retrieved reviews.
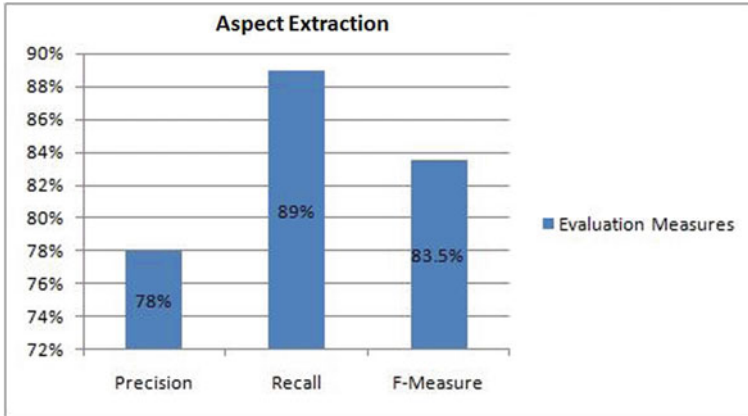
$$Precision = \frac{TP}{TP + FP} \tag{1}$$

Fig. 4 Parameters for evaluation for aspect extraction

Recall

It shows completeness. Itmeans, it is the measure of relevant instances that are retrieved.

$$Recall = \frac{TP}{TP + FN} \tag{2}$$

F-Measure

It is the measure of overall accuracy.

$$F - Measure = \frac{2(Precision * Recall)}{Precison + Recall} \tag{3}$$

Aspect extraction provides accuracy of 83.5% using Association Rule Mining. Sentiment orientation provides accuracy of 93.6% for given dataset. Precision, Recall and F-measure for aspect extraction and sentiment orientation are shown in Figs. 4 and 5 respectively.

6   Conclusion

Proposed method extracts more relevant features as it checks previous word of features extracted. Analysis of experimental results for proposed method is done with parameters like precision, recall and F- measure. Some existing methods consider only nouns as features but all nouns are not necessarily be the features. So proposed
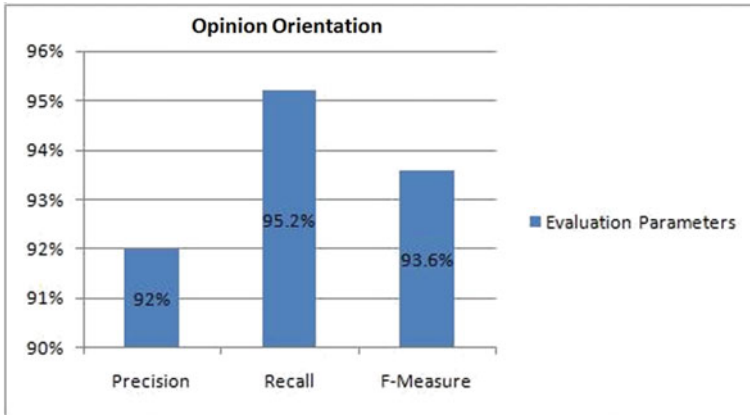
Fig. 5 Parameters for evaluation for opinion orientation

method overcomes this limitation by checking various associations among pos tagged words and thus generates final summary.

In future, the work can be done to find features and classification of various models of mobile phone by combining various methods of classification to get more accurate results.

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Unconventional to Automated Attendance Marking Using Image Processing

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Abstract The traditional method of raising your hand in a classroom to say "present ma'am" or "yes ma'am" or whatever other things you would say is kind of fading away, Image processing is becoming increasingly important in the digital world. Magicians play an important function in today's information era. Visual processing is necessary in the area of biometrics to identify a individual whose biometric image has already been saved in a database. Image based biometrics, such as faces, biometrics, and eyes, need image processing and pattern recognition algorithms. To perform correctly, an image-based biometric system requires a sample image of the user's biometric that is highly clear and unadulterated. This study proposes the development of a system that automated stamps students' attendance using automated image render ways such as facial detection and identification. Face recognition is challenging due to factors such as face pattern, orientation, shape, varied patterns, and the complexity of face expression. Using multiple datasets, the system is taught to identify the face-representing pattern (positive pattern of face) and set it apart from the surroundings (critical pattern of facial expression) environment. The major goal is to provide an autonomous platform for recognising faces in video, as well as documenting student attendance by identifying them from their various face patterns. This aids in the automatic maintenance and management of the attendance system.

Keywords Attendance maintenance · Manual attendance · Pattern recognition · Facial detection · Viola jones · Fisher face

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1 Overview

The facial picture has become a crucial biometric identity. element that is easily accessible and does not necessitate any special or physical connection between the user and the gadget. As can be seen, picture identification is a complex also a difficult task that involves a range of factors such as rigorous, direction, verbalization, and dimensions. All suggested method is designed to find and recognize a person in a video by their face. The entire system is impulsive and produces accurate results, making the student record present absent accurate in the ever-changing world of technology. The literature survey is shown in Sect. 2, the proposed system is shown in Sect. 3, the experiments and results are shown in Sect. 4, and the conclusion is shown in Sect. 7.

2 Survey of Literature

For a multitude of reasons, individual identity is critical in today's world. In terms of correcting data loss, Realtime applications of these approaches have several drawbacks [1]. The author describes the use of image processing to automatically recognize faces in video content. Various detection and recognition procedures are illustrated, along with details on the algorithms used to execute these strategies.

Face recognition technologies are classed among many other things, depending on the individuals personal look, face geometric structure, and color of skin [2]. A portion of the image.

The retrieval of depth features is used in preprocessing approaches to detect and recognize in relation to geometric changes and texture. Detects faces via edge mapping and skin color thresholding. A real-time Adaptive Boosting face feature education method was suggested by Viola- Jones. Wang used advanced better feature categorization to correct for differences in light, strength, configuration, and characteristic decomposition.

Facial pattern detection is gaining popularity in face, other detection authentication since it does not require direct user interaction. Pattern recognition includes face recognition. Fisher faces and Eigen faces were proposed in the early 1990s. Fisher faces perform better than Eigenfaces [3]. Eigen and Fisher face are presented by Belhumeur et al. [4] as face recognition methodologies based on features. This functionality technique use non-linear aspect spaces to ensure security in the face of changing lighting and position. The utilization of arithmetic and geometrical properties such as facial segments, areas, and perimeters aids the identification process.

3 System Proposed

The proposed solution aims to automate the recordkeeping process. To achieve the project goal, video clips of the classroom lecture are first recorded. During video pre-processing, unwanted artefacts such as noise and other invariants are removed. The next level demonstrates how to recognise people and discern faces in challenging environments. This strategy aids in the identification of students, the tracking of their attendance in class, and the prevention of illegal pupils using proxy attendance. The four stages of the system's development include video acquisition, face identification and cropping, feature extraction, and face recognition. System Workflow: Students will complete a system account with accurate information and face photographs collected from various areas angles. After the enrollment procedure is completed, enter the students' information into the database. Media capture is accomplished by videotaping a classroom session. Using image processing method such as the V-J Algo Recorded film was used to detect and distinguish the features of different students and distinguish them from the backdrop using face detection, resizing, and the Boolean Facial Algo for face identification. Information about students' personal lives.

For verification, the children's facial photographs are compared to those in the database. If the students' faces match, the system tracks and updates their attendance. It also assures that once a student's attendance has been recorded, it will not be updated again (i.e., 1 individual = 1 presence).

The system's operation is depicted in Fig. 1.

Here are the two main algorithms that are used.

3.1 Adaptive Boosting (AdaBoost) or V-J Algorithm

V-J created the first real-time face recognition method, which assisted in the detection of faces in photographs. This implementation uses an algorithmic specification in its entirety., including feature computation using integral pictures, feature selection using Adaptive Boosting training, and cascade for maximum efficiency computational resource allocation. This algorithm detects quickly and accurately.

Figure 2 displays a picture Set a detection algorithms snapshot. Facial recognization is computed using the V-J method. There are four steps in the V-J algo.

3.1.1 Haar Quality Selection

In Haar image segmentation, calculate the gradient magnitude between the picture and the Haar patterns. Subtract the amount of dark pix from the number of light pix to generate a range of characteristics.
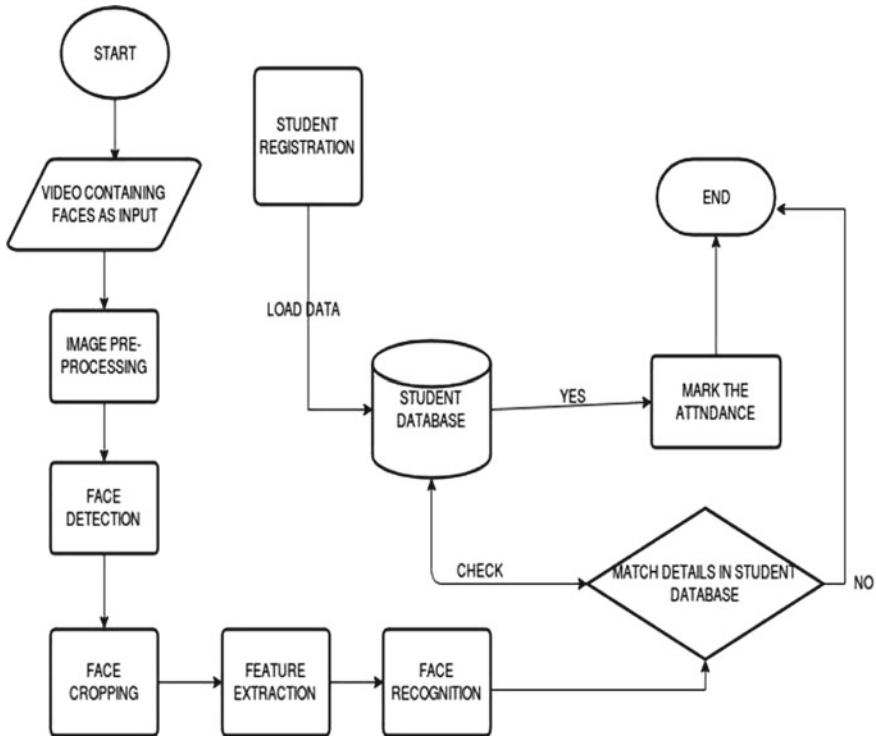
Fig. 1 System model representation

To account for the effects of varying lighting situations, all photos are normalised using mean and variance. Images with a With limited information of interest, deviation levels just under one are ignored.

Five Haar forms are shown in Fig. 3 for computing various attributes from facial photographs. To compute all the features, these haar pattern labelled with dark or light pix are moved across an area. These traits aid in the detection of faces in photos with minimal computation.

3.1.2 Generating a Image

All integral image can simply calculate the number of pix digits in a given area of picture. It's mostly taken to figure out what an image's mean intensity value is. number in all pix (o,p), who is the add of pix over (o,p) and pix to the other side of (o,p) within a rectangle area. Number in the Added Area Box at (o,p) for an integral image is easily determined by:

$$Q(o, p) \;=\; V(q, i) \;+\; D(q - 1, i) \;+\; D(q, i - 1) - D(q - 1, i - 1)$$
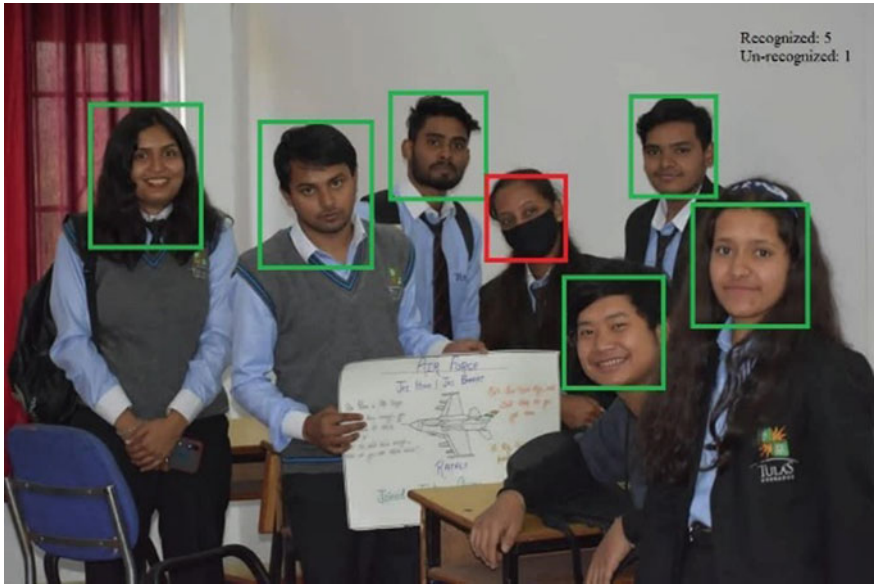
Fig. 2 A view of the face detection window

Fig. 3 Haar patterns

And D(q − 1, i) is the pixel value directly to the left of (q, i), D(q, i − 1) is the pixel value directly to the right of (q, i), and D(q − 1, i − 1) is the pixel value to the top–left of (q, i) (q, i).

3.1.3 Adaptive Boosting Training

Adaptive Boosting learning is used to choose a subset of features and create a classification. The word "Adaptive Boosting" heads toward pointed ways of boosting a coordination. In a coordination's, every weak learner is fed into a response giving the class of the item. From a huge number of weak coordination, this approach builds a strong one. Adaptive Boosting training is used to help the evidence of success its categorization performance.

The coordination is trained in the following way: Each testing set of value instance is sized. Let the starting size as follows: size (wi) = 1/Z where Z is the number of practicing values.

Weighted examples are used to create a base coordination based on the training data.

Determine the phase value for the practice set to give sized using the equation below:

$$\text{phase} = \ln((1 - \text{error})/\text{error})$$

error is miscalculation value.

Additional particular set have more size or more accurate, as shown by the staging weights. Contribute to the final forecast.

Use the formula to upgrade the size of a practice change

$$(w): w = w * \exp(\text{stage} * \text{train})$$

Here train is all about guessing error for practice ways and w is the sized for practice ways w.

To make the hard coordination, a large number of weak coordination are employed:

$$A(o) = n1a1(o) + n2a2(o) + n3a3(o) + \ldots$$

A(o) denotes a strong coordination, while n11(o) denotes a poor coordination.

3.1.4 Cascading Coordination

Cascade means unique type of getting in which many coordination are combined. The details covered specific coordination's output is being tryed as extra data again for cascade's following coordination. Many of "constructive" sets photographs of faces and random "de-constructive" pictures are used to give knowledge cascades coordination (i.e. background). The size of the constructive and deconstructive pictures are to be same. After the coordination has been given knowledge, these are used for recognizing faces in a picture. The searching box moves around the captured image in order to find the faces.

All over the picture, checking every coordination position (Fig. 4).

3.2 Fisher Face Algorithm or Linear Discriminant Analysis

In a real-time context, the Linear Discriminant Analysis (LDA) is employed for image identification. This approach is used to reduce dimensionality and classify data.
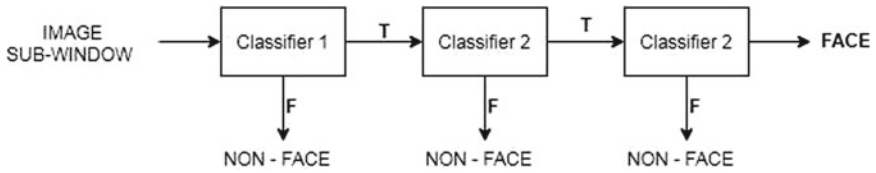
Fig. 4 Cascading coordination

The Linear Discriminant Analysis (LDA) or F-F Algo operates as follows:

- To the system, Determine the value of categories and their users.
- Calculate all training chart sets mean (y) and each class's mean face value (ti). The formulated equation as follows:

$$y = \frac{1}{L} \sum_{i=1}^{1} i \cdots \tag{1}$$

The following formula was used to obtain all arithmetic value of all sets:

$$y_i = \frac{1}{l_i} \sum_{j=1, j \in i}^{1} j' \cdots \tag{2}$$

- Calculate the Sc (inner set of dissipate model) & Rr (inter-set dissipate model).
- Calculating the principal value.

  Eigen Value = inner set dissipate model.

- Calculate the entire scatter matrix to get the PCA projection matrix.
- Determine the best projection matrix WT_o.
- Using the choice projected model y op, calculate the Number of every image's WSized. pix.
- The formula to compare the face picture to the arithmetic value of the practice data:

$$Y_{input} = X_{input} - t \ldots \tag{3}$$

Calculate the test before transforming the picture data to the optimal projection matrix, the image's refinement quantity.

4 Experiment and Their Outcomes

School class films collected with a cctv system using a high-Res of 1920 × 1088 in the suggested system. To collect different frames from videos, preprocess them. After then, frames are used to recognize a human face against a complex scene. On the Python 2.7.13 platform, the technique is applied using OpenCV 2.4.13 instructions. The precision for facial recognition and processing is used to record the results.

5 Sample Data

Data model of constructive (face) and deconstructive (environment) photos are developed as part of the experiment. 1249 constructive and 1051 deconstructive pictures are used in the practice way. The training pictures are all in JPEG format and 640 × 480 pixels in size. For the detecting process, training photos were employed.

For the purpose of recognition, 16 pupils have been registered. Each student's model, which consists of 80–90 face photos, is placed inside data model in a practice image as processing using the eliminated features. Every photo is 125 pixels wide and in JPEG format.

6 Observation Experiment

Face recognition has been demonstrated to be attainable with near-perfect results after repeated trials and extensive training of the picture collection.

Frames from movies are taken at a regular period of 2 seconds in this experiment. These frames were used to count how many people are in the system.

Captured facial features from the window frames are checked using enrolled students' data by comparing the different ways in the defined models (DB).

Single captured windows from the school class footage are shown in Figs. 5 and 6.

We've collected two picture frames to assess the correctness of the experimental outcomes. Both frames are compared, and it is discovered that the outcomes vary depending on the lightning circumstances. Additional facial accessories have also been discovered to have an effect on the findings. For example, whether or not the student wore spectacles, hats, or other accessories during registration and during facial identification from the video footage.

Table 1 illustrates the findings for the two frames, as well as the accuracy of facial image identification in each frame.

Fig. 5 Captured frame

Fig. 6 Face detection in the frame

Table 1 Face recognition accuracy results

	Set1	Set2
Number of students	7	18
Number of students detected	7	18
Number of students recognized	6	15
Number of students un-recognized	1	3
Accuracy	60%	60%

7   Conclusion

The match of Set 1 and Set 2 is 60% and 60%, respectively, based on the findings collected from both frames.

   This system was created to automate the tracking of attendance. The major goal in establishing this system was to eliminate all of the disadvantages and unusual techniques of manually handling attendance. Traditional techniques lag behind the system's efficacy, resulting in time and paper waste, as well as proxy attendance, which is avoided with an automated system. To address all of the disadvantages of manual attendance, this framework would be a better and more dependable option in terms of both time and security. In this approach, an automated attendance system aids in the differentiation of employees.

   In the images of school class and identify the image perfectly to mark the presence. The effectiveness of organization is improved by the more practice data model.

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Synthetic Animations Based Dictionary for Indian Sign Language

Annu Rani, Vishal Goyal, and Lalit Goyal

Abstract The Indian Sign Language (ISL) is the natural language of the Indian deaf community to convey their thoughts, feelings, ideas, etc. with other people. ISL has a bulk of real human video sign language dictionaries but our main motive is to create the ISL dictionary by using synthetic animations which use virtual character Avatar (computer generated cartoon) instead of human videos. Because synthetic animation has more benefits as compared to real human videos in the terms of uniformity, cost, memory usage, and adaptability. As part of this project, a dictionary of English text to ISL was constructed as part of a translation system. Using a third-party programme called eSign editor Software, the English words are translated into Hamburg Notation System (HamNoSys). The HamNoSys code is then converted into a SiGML script, which is then translated into an animated sign by a 3D computer-generated cartoon. The produced dictionary contains a total of 3051 words, making it suitable for use in a translation system that converts spoken or written sentences into sign language motions for use in a deaf school. It's a time-consuming and challenging task, but it's a vital stage in the machine translation of all English text into ISL with 3D animations.

Keywords Avatar · Deaf people · HamNoSys · ISL dictionary · Sign language · SiGML · Synthetic animations

1 Introduction

Sign language is a visual gesture-based language used by deaf and mute people for their conversation [1]. Sign Language consists of manual and non-manual [15] parameters. Manual parameters [18] include hand shapes, orientations, locations, straight movements, circular movements. Non-manual parameters include eyes-gaze,

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shoulder movements, body movements, head nods, face expressions, lips movements, etc. Every word has its sign. As with spoken languages, there are numerous varieties of sign language [12]. But all sign languages are not same all over the world because it changes from region to region, nation to nation and country to country due to cultural and geographical variations, historical context, environmental facts, etc. Each nation or country has its sign language. For example, the British Sign Language (BSL) and the American Sign Language (ASL) are quite different and mutually unintelligible, even though the hearing people of the United Kingdom and the United States share the same spoken language. Sign Language is a complete and natural language. Every sign language has its signs and grammar rules correspond to a word or sentence [13]. It is estimated that more than 200 sign languages are available which are used by deaf and mute people in the world [20].

2 Dictionaries of Sign Language

A lot of work had been done for the construction of sign language dictionaries all around the world. These dictionaries were created for SL in a variety of countries, including China, Korea, the United States, and Vietnam. Real human videos or 3D computer-generated avatars were used to create these dictionaries. Suzuki et al. [21] had constructed a multilingual sign language dictionary for three gesture languages which consist of Japanese gesture Language, Korean gesture Language, and American gesture Language. On the system, the user can control the speed of sign language motion and select the targeted language. Fuertes et al. [6] developed bilingual dictionary for two languages which include Spanish Sign Language - Spanish (DISLE). This dictionary is available in electronic form for the hearing impaired community. The system provides two options to users for word search either in signs or Spanish [bilingual sign language dictionary]. Franc Solina et al. [19] developed a multimedia sign language dictionary that translates Slovenian text to Slovenian Sign Language (SSL). The multimedia dictionary has included 1800 individual signs in the form of video clips. The words that are not presented in the sign language dictionary or the name of persons are represented by finger-spelling [11, 16]. This dictionary was not only useful for reference purposes but also useful for learning in special educational institutions for hearing impaired people, as well as for normal people, who want to learn sign language. Cormier et al. [5] prepared a BSL Sign Bank dictionary for BSL. It includes 2528 words of signs in the form of human video clips. All the sign videos were recorded by the deaf using BSL. Martin et al. [14] constructed an ISL dictionary for disaster warnings. The messages were traced to translate them into 2D avatar animations. The dictionary gives information related to the disaster domain to deaf people in sign language. It includes 600 sentences and 2000 words related to disaster messages. Goyal et al. [8] developed an ISL dictionary using synthetic animations. The dictionary contains 1478 words signs in the form of 3D avatar animations.

3 Techniques and Methods

Hamburg Notation System (HamNoSys) was developed by Siegmund Prillwitz in 1984 at the University of Hamburg, Germany [10]. It is a phonetic transcription system based on stoke notation that can be used for other sign languages. This sign writing notation was developed for the construction of SL dictionaries, machine conversions. It has included 200 symbols which are covering all hand shape gestures as signing parameter that holds hand shapes, orientations, locations, and movements of hand [22].

3.1 eSIGN Editor Software

The eSIGN software consists of two components: the eSign Editor and the JASigning Player [2]. The eSIGN Editor program was developed by the eSIGN project team to allow us to create gestures in the forms of HamNoSys code and convert it to the SiGML script [24].

3.2 SiGML

SiGML is a Signing Gesture Markup Language that is used to represent HamNoSys symbols [3]. The HamNoSys symbols are described in the form of an XML scripting tag for each word. It provides many tools to display the sign of input HamNoSys code in the form of animated symbols and animated videos for communication purposes.

3.3 Synthetic Animations

Avatars are represented as 'Virtual bodies' to display input [7]. HamNoSys [23] notation for sign language is readable by three-dimensional (3D) executing software. It takes input as a SiGML file or XML tag and generates output as synthetic animations or avatars corresponding to the input word or text. Animations frames are given as input to the avatar in a sequence for each inputted text. When these frames are placed in a sequence of poses, then rendering software produces synthetic sign animations [17] corresponding to the specific frame definitions. Synthetic animations can be generated in real time reducing the time [9] and storage requirements to a large extent.
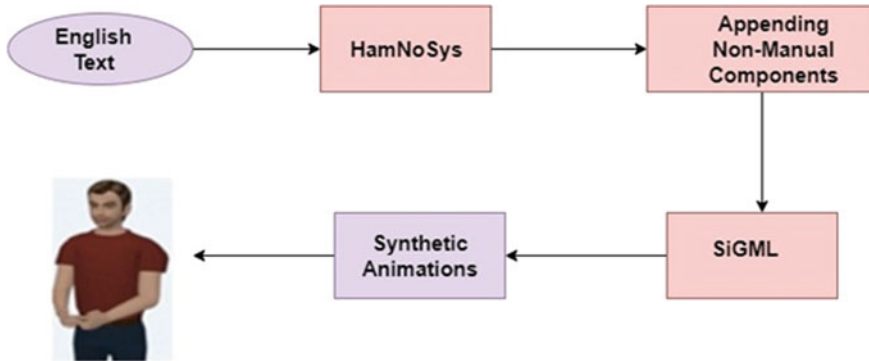
Fig. 1 Steps construction of ISL dictionary

3.4   Construction of Proposed ISL Dictionary

The proposed steps for construction ISL dictionary is depicted Fig. 1.

- English Text: The system takes English text as input. English word can be days of week, month name, basic phrases, dishes etc.
- HamNoSys Code: This module convert English word into HamNoSys code by following the structure rules of HamNoSys tool.
- SiGML code: This module converts HamNoSys code into SiGML code by following SiGML conversion rules.
- Synthetic Animations: At last SiGML Player plays the SiGML file and generates synthetic animation corresponding to SiGML script file.

4   Comparative Analysis of Current System with Existing Systems

Various existing systems are available to represent sign language. Around the world a lot of work has been done to represent sign language worldwide. Several existed systems have been constructed in the form of pictures which has become oldfashioned. In the modern era of digitization and computerization, Some existed systems have designed using human videos but it required lot of time for recording and space for storage. We designed our current system using synthetic animations that required limited space for storage and time for execution. But it does not looks natural as human videos (Table 1).

For the accuracy purpose these signs are matched with ISLRTC videos. These signs are also verified by ISL interpreter and the students of deaf schools. Some signs screenshot like show, keep, and happy shown in Table 2.

Table 1 The total number of words implemented

Category of words	Total number of words	Number of words implemented
Verb	585	493
Pronoun	37	29
Preposition	38	32
Numbers	35	28
Noun	1879	1779
Interrogative	21	18
Determiner	11	9
Adverb	60	52
Adjective	385	308

Table 2 Sample of words implemented

Word	HamNoSys code	Non-manual code	3D avatar animation
Show	(HamNoSys notation)	`<hnm_mouthpicture picture="S@_U"/>`	
Keep	(HamNoSys notation)	`<hnm_mouthpicture picture="ki:p"/>`	
Help	(HamNoSys notation)	`<hnm_mouthpicture picture="help"/>`	

5 Result and Discussion

We developed bilingual English text to ISL dictionary using synthetic animations. Unlike other spoken languages such as English, French, Hindi Punjabi, Tamil, etc. sign language cannot be in written form. HamNoSys is a notation system that can be used to write any sign language. This notation system can represent both manual and non-manual [4] parameters of signs. The eSIGN editor software is used to covert HamNoSys code to SiGML code. Then SiGML player generates animations by using the SiGML file. Currently, we have a collection of 3051 words that are used in

daily life. 2748 words are transformed into HamNoSys symbols from this list. Name of person and unknown words are finger-spelled. The words are classified under the categorization such as alphabets, numbers, noun, verb, pronoun, interrogative, preposition, etc. are shown in Table 1.

6 Conclusion

In the current task, English words to ISL dictionary has been constructed for Indian gestures using various resources such as ISLRTC (Indian Sign Language Research Training Center) dictionary videos and some videos were recorded by expert ISL interpreters. Using computer generated avatar technology is much superior than using real human video because it consumes less storage space, takes less time for translation, SiGML files can be easily uploaded and downloaded without any delay and the virtual character customised to the user's preferences. The dictionary can be used in a translation system that converts English text into gesture language and can be used in deaf schools for education. In the future, more signs will be added to extend this dictionary.

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Optimization Methods for Image Edge Detection Using Ant and Bee Colony Techniques

Sachin Kumar, Sandeep Kumar, Brajendra Kumar, Sandeep Sharma, and Harshita Chaudhary

Abstract In a computer image analysis, the main aim is to produce the image with specified appearance that provides more convenience for society and machines to detect, identify, and understand the situation. Image processing is the technique from which we can get any digital information that is stored in the form of images. "Appearance Edges" are very important feature of image inquiry and clarification. "Edge Detection" technique can be applied for extraction of edges from the image. By applying these techniques, we can get every small details of an image and unwanted details of the image can be discarded resulting in fewer amounts of data to be processed. ACO and BCO are well known meta-heuristic search algorithms used in explaining various combinative optimization problems. In this paper we are hybridizing the ACO and BCO algorithms to optimize the feature selection. The simulation results show that our proposed hybrid algorithm provides promising and optimal selection of features. We used Python's simply framework for virtual simulations.

Keywords Ant colony optimization (ACO) · Edge detection · Swarm intelligence · Bee colony optimization (BCO) · Digital image · Meta-heuristic techniques

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1 Introduction

The Edge Detection technique is an imperative method in any image processing technique that can be used to find the limitations of objects within a given particular image. It works by identifying gaps between different features of images such as brightness, contrast, color, texture, etc. Notable Changes in an image are called edges. An edge in an image is a notable local change in the image strong point, usually associated to a gap in either the image strength or first derived from the image strength. Gap in the image strength can be either "Gap in the steps" or "Line Discontinuities". Gap in the steps occurs when the image strength suddenly different from one variable on one side of the gap to a different variable on the other side. Line Breaks occurs when the copy strength suddenly changes variable but then return to the starting value on the other side.

This technique is very important to understand the details of the copy & takes its persistence in the image study and machine vision. Main goal of edge detection is to remove most noticeable pixels is visible in an image, which are anticipated to be the borders of objects that influence production of unexpected fluctuations in the strength of the image [1]. Most of the details of an object of the image are confined to the edges. So, firstly we will discover these edges in an image and then utilize these filters to intensify those regions of the image which consists of edges and then the sharpness of the image grows, as a result, it becomes easy to interpret. Edge detection is very usual method for discovering notable gap in strength values [2]. Optimization methods can be defined as those which give the best result of a problem in any situation. It is applied to explain bit difficult computational resolutions. It finds the good outcome from the given practicable resolutions (Fig. 1).

ACO is a bio-inspired method depends upon the usual method that means ants deposits pheromone on the ground to make the positive and easy way that must be trailed by other associates of the ant colony [3]. In ant species, an ant mobilizing to and from a food cause credit some material on the path called pheromone. The probability for ant to go to a destination is concerned with amount of pheromone

Fig. 1 Flow chart for edge detection
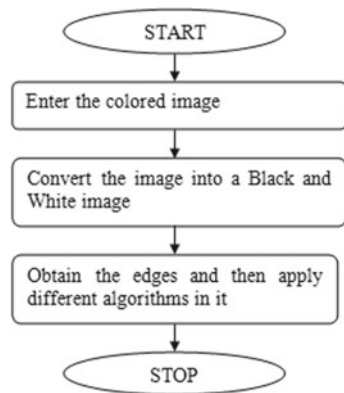
that each intermediary watches through its inspection. It is a probabilistic technique and meta-heuristic for solving computational problems.

Bee Colony Optimization is a meta-heuristic method that gives newly path in the technology of swarm intelligence. Bees are represented agents who can solve any combinatorial optimization problems. Mainly, three types of bees exist in the beehive [4]. They are Queens, Drones and Workers. The bee colony optimization procedure has the capability of working with both constrained and unconstrained optimization. The ABC algorithm imitates the hunting conduct of a bee colony.

2 Literature Survey

M. Dorigo, M. Birattari, and T. Stitzel, "Ant Colony Optimization Artificial Ants as a Computational Intelligence Technique, IEEE Computational intelligence magazine, November 2006.The key motive that item is to manifest ACO that is been standardized into a procedure that is designed to find a better finding too difficult optimization problems for combinative optimization complexities by Dorigo and other writers. Metaheuristic is a bundle of unconventional methods that is solve to describe experiential approaches speculates to a bunch of various issues. "Ant Colony Optimization" IJCSNS VOL.8 No.6, Jun2008.

In this paper, it is shown that Ant Colony Optimization is a biological process due to its analog's simplicity and group behavior. This paper reveals the Ant Colony Optimization as a distributed method that has been used to solve the Travelling salesmen problem. It shows the case study of Jordan's Seaport Motion.

This paper speculates how the use of digital photography has changed the era to a great extent and is creating the path to new forge images. A method for copy-move fake detections has been used. But this method takes into consideration only the shifting of derived areas. The Planned system shall complete the demerits of both the structures and could be strong to different methods of copy-move processing. All the methods indicated draws attention from different conversions to make them vigorous and to lessen the sequence of logical blocks for comparison.

J. Canny "A computational approach to edge detection, IEEE Transaction on Pattern Analysis and ML, vol. (1986)". J. Canny. in the paper defines a different path edge detection. The achievement of the path relies on the clarity of a suitable compact result for the calculation of edge nodes. Then results should be sufficient to realize the anticipated behavior of the detector while making slight suppositions in the form of solution. We explain finding and localization plans for the classification of boundaries, and current mathematical calculations for these measures as functions on the operator impulse feedback. A 3rd rule is given to ensure that the indicator has only one response to a solo edge. We dispense a generalized technique, called feature amalgamation, for the fine-to-coarse incorporation of data.

Yigitbasi ED, Baykan NA (2013) Edge detection using artificial bee colony algorithm (ABC). Int J Inf Electron Eng 3(6):634–638. An edge detection the arena of copy development is a vital implementation. Image processing is being used in

numerous areas. For this motive, a method used is giving clarity and concept which is about computer image systems is being established for fewer mistakes. Firstly, the ABC algorithm is elucidated. Succeeding this, edge discovery with the ABC algorithm is explained. Finally, the outcomes are revealed. The outcome figures out the projected method that can be practiced for edge discovery operations.

Alatas, B. (2010). Chaotic bee colony algorithms for global numerical optimization. Expert systems with applications, 37(8), 5682–5687. Artificial bee colony (ABC) is the latest bio-inspired heuristics for optimization glitches. Like the confusion in original bee colony behavior, this article suggests new ABC processes that use disordered plots for parameter adaptation to recover the merging qualities and to prevent the ABC to get fixed on derogatory resolutions. It is observed that the outcome methodology in this article increases the resulting quality.

Cumin Liu, Xiaojun Wang, Na Shi, and Ceiling Li, "Image Segmentation Algorithm Based on Improved Ant Colony Algorithm", International Journal of Signal Processing, Image Processing, and Pattern Recognition Vol. 7, No. 3, pp. 433–442, 2014In their article gives an improved kind of ant colony algorithm for image division with high productivity and an improved edge detection pathway. Few intense developments are: in the initial phase of segmentation. In the later stage, they presented an edge searching plan to the edge of the image.

3   Proposed Methodology

The method which is proposed in this work suggests various outcomes which deal with two optimization algorithm that is ACO algorithm, BCO algorithm. These algorithms deal with the searching behavior of ants and bees. Both are swarm intelligence techniques which are nature-inspired and meta-heuristic techniques which means a problem independent way which can be applied to various large-scale problems.

3.1   Ant Colony Optimization Approach (ACO)

In ACO while moving from places, ant leaves a liquid-like substance known as a pheromone in its route which helps another ant to find its path [5]. The newly proposed methods of ant colony algorithm are:

Initialization

This is the first and foremost step of any algorithm because without initialization a user cannot assume what variables are to be used, whereas in ant colony optimization various ants are placed on any random path. In which the ending point of any image will be initial pixel with a pheromone track which is set to as the grayscale perceptibility.

Pixel Evolution regulation

Pixel is defined as it is the minute area of illumination in an image. The acceptable adjacent pixels for the nth ant to move to the ones not which are not on the list.

Pheromone update rule

Negative response is detected through the pheromone disappearance.

Stopping Criterion

The above second and third types are repeating again and again till the desired objective of the ants are attained.

3.2 Bee Colony Optimization (BCO)

Bee colony comprised of employed bees, onlookers, and scouts. Each single food destination has only one working bee [6]. Then count of employed bees is equivalent count of a food destination, which is also equivalent to the amount of spectator bees. Scout bee case depends on food destination situations. The proposed approach is given through the below process:

Initialization:

The first step is the initialization which declares the dimensions, area of the colony, total count of working bees. Runtime: no. of frequency the algorithm will execute.

Max Cycle:

Number of rounds for searching. β: constraint to describe the verge on the number of answers designated during runtime.

Limit:

A solution that cannot be improvised through several trials is restricted. The Execution of further steps is defined for "run time" and "max cycle" which runs in iteration till the user aim is fulfilled.

(1) The Dimension of the size of the bee colony can be determined by:

$$L = \sqrt{P * Q} \tag{i}$$

where

L = Entire no. of sources.
P = Rows of the image.
Q = Columns of image.

(2) After determining the size then we have to see that the location of the basis is in working bees

$$\text{Located Source No.} = T/2 \tag{ii}$$

(3) Calculation of probability

$$P_i = (fit_i) / \sum_{n=1}^{TN} fit_n$$

i {1,2,3……..TN} and fit_i is the fitness solution

(4) Onlooker Bee Phase

Higher the fitness values there is more probability of onlooker bee to choose it.

(5) Scout Bee Phase

This is the phase where a solution as a whole depends on the number of trials and then the employed bee becomes a scout bee.

(6) Finding Best Solution

The best and improvised solution for bee swarm can be taken from using all the steps of BCO.

Both ACO and BCO which is been, illustrated under the section proposed methodology are the improvised version of Optimization algorithms based on their complexity, Time consumption, and various other properties.

3.3 Hybrid Algo. For Ant and Bee Colony Optimization (HABCO)

The algorithm for the Hybrid technique is:

(1) Read the image. The first step of any of the algorithms is to get the input and read the image. The Image can be of JPEG, JPG form.
(2) Get the height and width. The second step is to get the height and width of copy so that the projected method can be applied to it.
(3) Apply the Gaussian filter. Gaussian filter is defined as the linear filter which can be used to blur the images, reduce noise, contrast every detail of the image.
(4) Apply Normalized Gaussian smoothing: It is a convolution operator which is a combination of two mathematical functions which gives the result as a third function. The functions that are used in image processing are called kernels. The kernel can be considered as a square array of a pixel.
(5) Apply Normalized Horizontal Gradient. Normalized Vertical Gradient. Applying the approach method in all prospects of copy in X and Y-axis. Image Gradient is well-defined as the directional change in the strength and shade of the image [7].
(6) Track the Edge angle of the image: In an image, the detected edges are taken into consideration and then by edges, the angle can be demonstrated.

(7) Apply the Threshold: The Threshold is used to classify the pixel values in an image. It is one of the easiest methods for the segmentation [8] of images. The contribution for any thresholding option is the grayscale image or color image. The output comes as a binary image.

(8) Get the edges.: The last step is the final stage where we get the edges of the image with the new algorithm.

4 Results (On the Basis of Image Resolution)

A. **ACO Resolution**

See Fig. 2.

B. **BCO Resolution**

See Fig. 3.

C. **HABCO**

See Fig. 4.

Fig. 2 Result of ant colony optimization

Fig. 3 Result of bee colony optimization
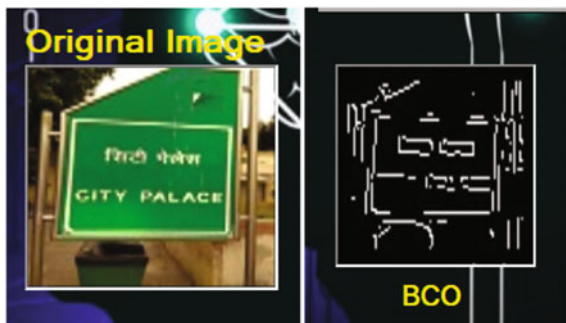
Fig. 4 Result of hybrid
algorithm for ant and bee
colony optimization
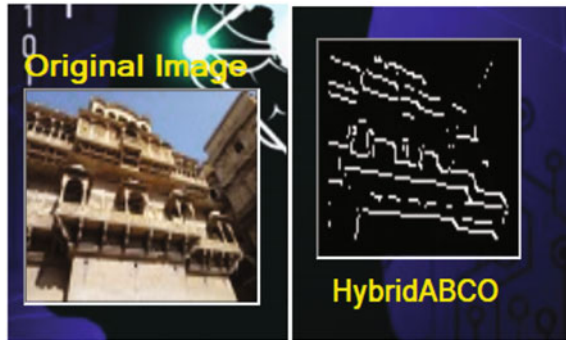
5   Conclusion

Edge detection is an important method of digital image processing. It is favorable for many research areas of computer vision and image segmentation. Edge detection furnishes important information for high-level processing assignments [7] like feature detection [9] etc. The favorable outcome of edge detection depends on the optimal calculation of the threshold. In this paper, a modified approach is used for techniques that are used under swarm intelligence that are Ant colony and Bee colony optimization for edge finding of the image. It is far better than the traditional approach. The newly proposed method is based on the probability of fitness function, Pixel transition rule, dimensions of the colony, Grayscale visibility, whereas some of the mathematical terms such as standard deviation, mean deviation.

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Review of Feature Extraction Techniques for Fake News Detection

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Abstract The widespread use of social media channel, as well as the development of these networks, has offered a platform for fake news to propagate quickly among people. For society, social media may be a two-edged weapon, serving as either a simple avenue for exchanging ideas or an unforeseen conduit for disseminating fake news to a broad audience. With the rise of social media, individuals may now distribute information for free, with hardly any inquiry and fewer restrictions than earlier. Detecting fake news has become a major concern. Document classification can be aided by extracting features. The technique of extracting a set of significant features is known as feature extraction from supervised and unsupervised data to help with categorization. It is critical to correctly identify the text's relevant features. Many artificial intelligent models have been used to achieve cutting-edge outcomes in Natural Language Processing applications. Using online available datasets, the performance of various feature extraction algorithms is compared. Mainly the review is focused on NLP in which text preprocessing includes tokenization, stopwords removal, and lemmatization. Different techniques for extracting features like Term Frequency- Inverse Document Frequency (TFIDF) Vectorizer with Ngram analysis vectorization, Term Frequency- Inverse Document Frequency (TFIDF) Vectorizer with Ngram analysis vectorization, Bag of Words, and approaches for Word Embeddings like Word2vec, BERT, FastText, and GloVe are compared.

Keywords Feature extraction · Fake news · Text preprocessing · TF-IDF · BERT · Deep learning · Social media

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1   Introduction

There is a noticeable growth in the number of individuals utilising the Internet as a result of the development of internet technology. It causes people's information and news-consuming habits to transition from conventional to electronic, resulting in greater comfort and speed for both media suppliers and media consumers. With its ease, social media websites produce a lot of fake news information. False news is considered as a serious danger to democracy and society on a worldwide scale [1], media, and individual liberty [1, 2]. The availability of fake data on social media platforms has piqued academic interest, and it has become a hub for spreading fake news. Social media platforms wield enormous power. The expected daily amount of tweets is around 500 million, according to internet live analytics. Over the past few years, fake news has drawn a lot of attention, especially following the 2016 US election [3]. Strong political campaigns can readily manufacture rumors on Twitter, which are extensively shared by users and friends who are unable to discern their veracity [4]. A big drawback is that most of the sources that are thought to be reliable and popular for reference purposes, including Wiki articles can also be a source of false or misleading information [5].

Text data is the most basic and unstructured type of information. In most cases, it is produced in large quantities. Unstructured text data is easy for humans to perceive and analyze, but it is challenging for systems to comprehend. This massive text data is a valuable source of information and data. The procedure includes computing the word frequencies from the document as well as the full collection of documents to enable effective transformation and display of such data. As a result, extracting relevant facts from unstructured text data is critical. Feature extraction is a fundamental technique for extracting important characteristics in dimensionality reduction. Some interesting topics of research that deserve greater exploration include recognising genuine users, extracting useful news aspects, and establishing a genuine information distribution system [6].

Following is the breakdown of the remaining paper: Sect. 2 outlines relevant research employing various feature extraction techniques that aid in developing fake news detection algorithms using deep learning, as well as defining the problem of identifying fake news. Natural language processing techniques are covered in Sect. 3, followed by a conclusion.

2   Related Work

A news story that is intentionally and legitimately false is referred to as fake news [3]. Fake news is a kind of news report on social media contains purposefully inaccurate information [7]. Some typical feature selection and feature extraction approaches have been discussed by [8]. It is investigated to see how effective these strategies are

at achieving high learning algorithm performance. Because the classifier's prediction accuracy improves as a result. They've also looked at the pros and disadvantages of certain commonly used dimensionality reduction strategies. Khan et al. [9] gave the extraction of essential features from the dataset of COVID-19 fake news. For extracting the feature, the named-entity recognition (NER) approach was employed. Granik and Mesyura [10] implemented Bag of words (BOW) and Naïve Bayes algorithm using Buzzfeed dataset as a means of identifying fake news and achieved accuracy 74%. The limitation of this model was failed to identify the factor that has a adverse impact on the data. Jadhav and Thepade [11] presented a framework which facilitates in detecting and utilising recurrent neural networks and deep structured semantic models to classify the fake news tweets from the twitter dataset. TF-IDF and count vectorisation feature extraction methods have been used. Then the extracted features are given to the improved version of RNN which is Long Short Term Memory (LSTM) for classification. By using the suggested model, 99% accuracy is attained. Faustini and Covões [12] created a fake news detection programme that utilised machine learning algorithms and could be used across platforms and languages. Bag-of-words with TF-IDF and to extract features, methods for word embedding were applied. For text mining, this model used two Document representation algorithms namely word2vec and DC Distance. Gaussian Naïve Bayes, Random Forest, K-Nearest Neighbour (KNN), and Support Vector Machine algorithms were employed [13]. Linguistic Enquiry and Word Count (LIWC) feature extraction model had been engaged for the getting out the best features from the corpus. Bagging, boosting and voting classifiers, different ensemble techniques have been used for evaluating the performance over datasets. For the comparison of experimental results, multiple performance metrics are used. Kaur et al. [14] developed a ground-breaking ensemble voting system with multiple levels. Utilizing three datasets and twelve classifiers, the suggested system was evaluated. When employing word count vectorizer (CV), term frequency-inverse document frequency (TFIDF), and hashing vectorizer (HV) feature extraction techniques, the linear support vector, passive aggressive, and logistic regression, each perform best on their own. The proposed model outperforms the Passive Aggressive approach, the Logistic Regression method and the LinearSVC when using CV, TF-IDF, and HV extraction of features approaches. Agarwal et al. [15] presented GloVe model for text pre-processing, with precision values of 97.21%, In the prediction of fake news, rnn and artificial neural network have produced promising results. Kaliyar et al. [16] used Glove embedding vector model for measuring the closeness of words. Near about 20 thousand titles of the news are analysed in conjunction with machine learning classification algorithms, deep learning algorithms using Glove, word2vec, BOW and TF-IDF as word embedding model for observing the performance of different algorithms. This model (FNDNet) achieved the accuracy rate 98.36% [17]. TFIDF feature extraction have been employed for separating the features and removing the un-important words. The model is trained using four machine learning techniques: Linear Regression (LR), Gradient Boost (GDBT), Support Vector Machine with linear kernel, and Decision Tree (DT). Experimental results of Gradient Boost achieved higher F1 score among all the algorithms. Nasir et al. [18] proposed a GloVe embedding model for

converting text into numeric data which was given to deep learning system that is hybrid. For the purpose of classifying fake news, the model combines recurrent and convolutional computational models. FAKES dataset has 804 articles with a 60% accuracy rate and the ISOT dataset consists of 45,000 articles and gains an accuracy of 99.96%. It has been observed that large-scale datasets achieved high accuracy as compared to small-scale datasets. Elsaeed et al. [19] used TFIDF and Doc2Vec for extracting features from three publicly available datasets. To reduce the number of extracted attributes, experiments with the chi-square and variance analysis algorithms were conducted. The most effective classifier was an ensemble voting one.

3   Natural Language Processing

Using natural language processing (NLP), a branch of artificial intelligence, computers may better understand, translate, and analyse human communication. The three stages of natural language processing are data preprocessing, extraction of features, and word embedding.

3.1   Data Preprocessing

It means the steps taken to prepare data for data mining. Html tags, emojis, url's, punctuation marks, stopwords, and unwanted noise are removed from the given data. Stopwords removal, lowercase conversion, tokenization, and lemmatization are the common preprocessing techniques. Tokenization is a technique for separating data into smaller chunks known as tokens. These tokens can be used to perform additional semantic processing. While converting into root-form, lemmatization gives the dictionary meaning word.

3.2   Extraction of Features

To examine a large set of variables, a lot of processing power and memory is needed. Classification techniques may overfit training data, causing new samples to perform badly. Feature extraction is a method of overcoming these challenges by combining variables in order to describe data with sufficient precision. Text mining [20, 21] commonly employs extraction of features and feature selection. Content-based/ Stylometric-based, sentiment-based, user-based, and context-based feature extraction techniques with an emphasis on fake news. At many levels, such as characters, phrases, words, and characteristics at the level of the sentence, the use of function phrases or words for instance (i.e., n-grams), stylistic features are collected

from text content [22]. Sentiment-based includes consciously distinguishing, separating, valuing, and examining emotional states and abstract information that employs content inquiry and statistics. Classification could be positive, negative, or neutral. Bhutani et al. [23] created an innovative technique for identifying fake news that makes sentiment a crucial element to boost accuracy. User-based features include the personal digital data associated with the user. Social context-based features help in evaluating the characteristics of the distribution pattern of the online news. The features of a network are extracted by constructing specialised networks such as temporal, interaction, and propagation networks. Feature extraction methods that are commonly used Bag of words [24] and TF-IDF [25], Count Vectorizer [26]. A number of research examined in Table 1 contains the advantages and disadvantages of various feature extraction models and concluded that the success rate is better with feature extraction. Umer et al. [27] examined the effects of two deep learning models on feature reduction approaches (PCA and Chi-square). Due to their capacity to extract complicated features, neural networks are regarded as particularly powerful data mining algorithms. Instead of relying on existing conventional feature extraction techniques, researchers are actively working on transfer learning for feature extraction. Sharma and Garg [28] assigned categories to news statements, latent dirichlet allocation technique was used. For fake news detection, a multi-modal technique was presented that took into account both textual and image features.

In this paper we review with the below mentioned techniques of feature extraction:

Bag of words: In a Bag of Words (BoW) paradigm, statements are represented as a sequence of their individual words. BoW approach disregards the order in which the words were uttered as well as their context.

TF-IDF: Inverse Document Frequency is the name given to it. A term's TF-IDF value rises in proportion to how frequently it appears in a document and falls in proportion to the number of documents in the corpus that contain the term. In text mining, it serves as a feature weighting factor.

3.3 Word Embedding

When using text categorization and neural networks, the text in the input must be in vector format in order for the network to process it. Two of the most well-liked word embedding models for transforming words into practical vectors are Word2Vec and GloVe [29]. The vocabulary of word embeddings is trained using a huge amount of data to enable it to capture the statistical connections of each of the words in the corpus. Researchers have recently employed pre-trained word-embedding algorithms such as GloVe and Word2Vec to detect fake news. The capacity to train with huge datasets is the key advantage of employing these models [16]. Zhang et al. [30] proposed neural network built on BERT for multimodal fake news detection. Data was gathered for the multimodal fake news detection using the BERT algorithm, while the VGG-19 model, which had been pre-trained was utilized to capture image features. Kaliyar et al. [31] used Bidirectional Encoder Representation Transformer

Table 1 Details of feature extraction methods

Citation	Feature extraction method	Advantages	Disadvantages
[10, 24, 26, 32, 33]	Bag of words	Is simple to comprehend and implement	Doesn't keep the text in a document in the same order. Doesn't capture semantic connections between words
[12, 16, 20, 24–26, 34–37]	TFIDF	The TFIDF model incorporates data on both major and insignificant words	For larger corpuses, it go slowly. location in text, meanings, cross-references to other documents, and so on are not captured
[12, 16, 24, 27, 38–41]	Word2Vec	Retains the semantic meaning of text words. There is no loss of context information. The embedding vector is extremely modest in size	Inability to cope with new words. At the subword level, there are no shared representations
[42, 43]	Doc2Vec	No matter how long the document is, it will be represented numerically. It is more efficient than word2vec	For shorter documents, the benefit of utilising doc2vec is reduced
[6, 16, 18, 40, 41, 44–46]	GloVe	GloVe collects statistics on a corpus from both the global and local levels	As it employs global information, the inherent memory cost is slightly higher
[30, 31, 47–51]	BERT	On a huge corpus of unlabeled text, BERT has previously been pre-trained	When use it in large-scale production, it can be expensive
[40, 41, 52]	FastText	When learning word representations, it considers the internal structure of words	FastText is not faster than Word2vec. Create vectors even for incorrect words

(BERT) as a word embedding model for the designing of a deep convolutional neural network. This model was trained using the fake news dataset from Kaggle, which contains 1000 items that are both real and false. FakeBERT, which had a classification accuracy rate of 98.90%, was shown to produce more reliable findings. We review with the below mentioned word embedding techniques:

Glove: Glove representations are learned by creating a cross-reference vector of all of the terms in the corpus, and then using matrix factorization methods to

decrease the dimensionality. The public now has access to GloVe embeddings that have been developed and trained on a range of corpora.

Word2Vec: Word2vec is a multi-layer neural network for text processing that "vectorizes" words. It receives a text corpus as input and produces a set of vectors as output: feature vectors that represent the corpus's words.

Doc2Vec: Doc2Vec is an unsupervised method for learning fixed-length feature vectors for paragraphs, documents, and texts. Doc2Vec is capable of detecting word associations and interpreting the text's semantics.

BERT: BERT is a deep bidirectional form that was pre-trained utilising both left and right contextual conditioning from unlabeled text. The transformer is composed of a text-reading encoder. It also includes a translator, which is in charge of task-based prediction.

FastText: The Facebook Research Team designed FastText as a quickly learn word representations and text classification using this resource. FastText divides words into several sub-words. FastText can train with number of examples of textual data on a multi-core CPU so fast and predict rough unknown data over different categories in under few seconds using the trained model.

3.4 Experimentation Results of Existing Studies

The model's efficiency is highly influenced by the features and classifiers chosen. The choice of characteristics and classifiers was not a major emphasis in previous studies. Authors should focus their efforts on determining which algorithm is better for given characteristics. In deep learning studies, the concept of extracting feature is rarely used. Lengthy features of textual data necessitate the use of generative models, although just a few studies have considered this. We feel that studies focusing on feature and classifier selection could potentially increase performance. Simple CNN [16] when used with word2vec gave leading results. Using an ensemble technique with glove word embedding model, instead of a basic classifier yields better results [6]. Using RNN, LSTM, CNN, and ensemble models, many researchers have achieved great accuracy. In this domain, Sequence Generative Adversarial Nets, Restricted Boltzmann Machines and Generative Graphical representation were not investigated. Researchers are encouraged to try out these models. As the preferred NLP model, transformers have replaced RNN models like LSTM. Although BERT has been used to identify false news, this field has not yet seen the application of the Generative Pre-trained Transformer (GPT). We advise researchers to employ GPT to hone false news detecting techniques (Table 2).

Table 2 Accuracy of feature extraction approaches as well as the classification algorithms

Citation	Feature extraction techniques	Classification algorithm	Dataset	Accuracy (%)
[10]	Bag of words	Naïve Bayes algorithm	BuzzFeed	74
[24]	Bag of words	Dense neural network	Fake News Challenge FNC-1	89.23
[25]	TF-IDF	Support vector machine	BBC	97.48
[34]	TF-IDF	Linear support vector machine	ISOT	92
[24]	Word2Vec	Dense neural network	Fake News Challenge FNC-1	75.67
[16]	Word2Vec	Deep convolutional neural network	Kaggle	98.36
[42]	Doc2Vec	XGBoost	Twitter	77
[43]	Doc2Vec	Ensemble method (decision tree_logistic regression + bagging classifier)	Kaggle	88.08
[45]	Glove	CNN-LSTM	News Articles Dataset	72.5
[6]	Glove	Bi-LSTM-RNN	Kaggle	98
[31]	BERT	CNN	Kaggle	98.90
[48]	BERT	Capsule neural network	Politificat, Gossipcop	93, 92
[52]	FastText	LSTM	Kaggle	98
[41]	FastText	Bidirectional LSTM	Fake news detection	99.24

4 Conclusion

In this paper a review of several feature extraction methods is conducted in order to construct deep learning and intelligent machine learning fake news detecting systems. Several feature extraction algorithms offered by various researchers are reviewed, and problems with the existing algorithm are identified. Various features extraction, word embedding approaches are studied and discussed their advantages and disadvantages. To reduce the impact of unwanted text from the dataset, feature extraction approaches have been suggested as a pre-processing phase. Studies have shown that the type of data has a significant impact on the classification accuracy that can be attained with various feature reduction procedures. There is a very strong chance that some of the text's frequently occurring words will affect how well the deep learning algorithms perform. When they are trained using only the raw dataset and feature extraction. As a result, future work will concentrate on resolving the problems and proposing

a new feature extraction algorithm that will extract some new features while also improving classification accuracy.

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Agile Development Methodology for Software Re-engineering

Maulin Doshi and Paresh Virparia

Abstract Agile software development is often seen as a product development strategy to design and develop new software products. One of the biggest mistakes that most software development teams make is to consider software re-engineering as a part of their maintenance activities rather than an integral part of the product development lifecycle, and therefore, they don't consider a systematic development approach for re-engineering activities. Even the most popular agile development frameworks such as Scrum, Kanban, and SAFe don't have any specific guidelines for re-engineering projects. It is also commonly observed that most of the teams that used agile development methodologies faced several challenges and accumulated a huge technical debt due to their short-focused goals and lack of systematic re-engineering plans (Raza and Majeed in Int J Sci Eng Res 3(8):1–5 (2012) [1]). This paper describes the importance of continuous software re-engineering and the usage of agile methodologies to effectively achieve the re-engineering goals.

Keywords Agile development · Agile methodology · Agile framework · Software development · Software re-engineering · Automation

1 Introduction

1.1 Software Re-engineering

Software re-engineering is the evaluation and alteration of a software system to reconstitute it in a new form to achieve technical or strategical objectives as well as the evolving business needs [2].

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1.2 Agile Development

It is a development practice that focuses on building a product using short work cycles, incremental deliveries, continuous inspection and adaption through the collaborative efforts of self-organizing and cross-functional teams [3, 4].

2 Why Re-engineer?

2.1 Repay Technical Debt

In software development, technical debt refers to the indirect cost of implementing an easier and quicker solution instead of selecting the optimal approach that would require a longer implementation time. Such solutions usually have design constraints and eventually, they require a significant amount of rework to accommodate future requirements and maintenance tasks [2].

While working on enterprise applications, one of the most difficult aspects is to maintain a balance between the quality and the delivery timelines. Development teams often have to compromise with the quality and best practices in order to meet the sprint goals.

It is extremely important for product managers and development teams to identify the technical debts and have a continuous plan to re-engineer or refactor the solution to repay those technical debts.

2.2 Programming Language or the Development Platform Is no Longer Supported

When a programming language or the development platform used for the software or a part of the software is no longer supported, software re-engineering becomes an essential requirement to apply new enhancements, bug fixes and security updates [5].

In this situation, the important decision is to decide whether to re-develop or re-engineer.

2.3 Change in Business Processes

Business processes go through various changes throughout a software lifecycle to support the business needs, adhere to the legislative changes or enhance the user

experience [5, 6]. The software has to be re-engineered to cope with such changes in business processes.

2.4 Performance Optimization

The performance of a software depends on various factors such as the database, size of the data, hosting environment, caching mechanism, web services, APIs, class libraries and many other internal/external dependencies based on the type of the software [5].

There are several performance monitoring tools and techniques to identify performance issues and dependencies. The software then requires re-engineering to resolve the identified issues.

2.5 Modernization

Information technology is one of the fastest-growing and constantly evolving industries. Best practices today may become outdated tomorrow [5]. The most promising technology today may get replaced by a more advanced alternative in the future.

Software re-engineering helps companies and development teams to adopt the changes in technology and best practices to ensure that software doesn't become outdated too soon [5].

2.6 Risk Mitigation

Software re-engineering helps reduce or eliminate the potential risks with legacy systems such as dependencies on human resources due to the factors like lack of documentation, overly complex code, hidden bugs and temporary workarounds. Software re-engineering also helps to mitigate the risks associated with manual operations by applying automation wherever possible [5] (Fig. 1).
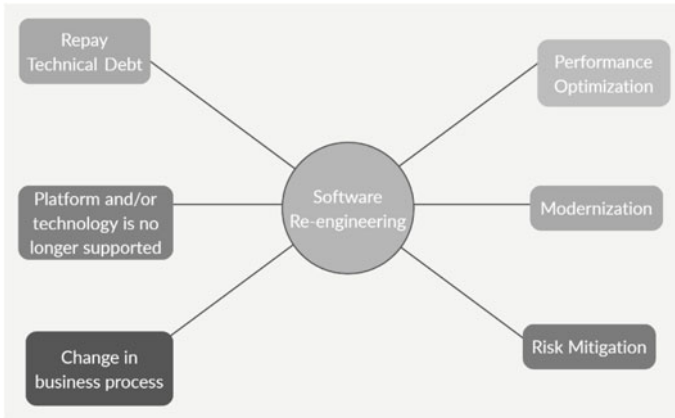
Fig. 1 Reasons that trigger software re-engineering

3   Software Re-engineering Activities

3.1   Current State Analysis

Analysis of the current state includes analyzing the application inventory, identifying the problem statement, and recognizing the candidates for re-engineering along with their priority, resultant expectations and the expected delivery timelines.

3.2   Document Reconstruction

Evaluate the existing documentation and update it if necessary. Documentation should not be excessive but should be sufficient enough to explain the software implementation and its coherence with the business processes.

3.3   Reverse Engineering

Reverse engineering is a process of recovering architectural design, codebase, data and procedural design from an existing software program [7]. Reverse engineering is one of the most critical phases of software re-engineering. The success of the re-engineering exercises heavily depends on successful reverse engineering [7].

3.4 Code Reconstruction

Code reconstruction refers to understanding and analyzing the existing source code to identify the dependencies and restructure the code. The refactored code is then tested to ensure that the software program still works as expected.

3.5 Data Restructuring

In this step, the existing data architecture is thoroughly analyzed. Necessary data models are defined in order to identify the data objects and attributes. Existing data structures are reviewed and fine-tuned or restructured to optimize the design and performance.

3.6 Forward Engineering

This step finalizes the re-engineering process by integrating the updated specifications depending on the results of the evaluation performed during the reverse engineering and the restructuring phases [6]. Updated software is delivered at the end of this phase to meet the original criteria of re-engineering (Fig. 2).
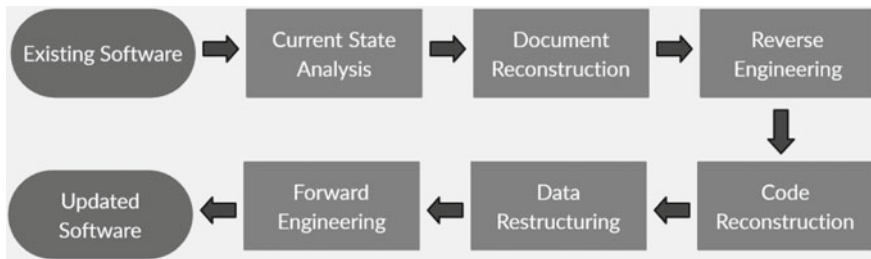
Fig. 2 Software re-engineering process flow

4   Agile Methodology for Software Re-engineering

4.1   Organizational Culture

Agile methodologies require a complete transformation in the organizational culture at every level of the organization to embrace and thrive in an adaptive, flexible, self-organizing, transparent and collaborative environment [4].

The entire organization needs to understand the purpose of continuous re-engineering and its benefits. Re-engineering must be seen as a necessary enhancement to the software with a dedicated budget and resources rather than considering it as an overhead. It is the agile coach's responsibility to educate and transform the organizational culture and mindset in order to benefit from the rewards of embracing true agility [9].

4.2   Re-engineering Is not a Side Job

Re-engineering should be part of the main project plan and the product development lifecycle. Re-engineering necessities should be identified during the stride appraisal and added to the product catalogue in order to plan their implementation during the upcoming strides.

The agile coach must educate the development team, product manager and all the other stakeholders about the technical debt, its consequences and the importance of continuous software re-engineering activities during the product development.

4.3   What Is a Stride?

A *stride* is a short period of time wherein a development team works to complete specific tasks to reach a milestone. It is similar to a *sprint* in the Scrum framework [4].

4.4   How to Use Agile Methodologies for Re-engineering Projects

The biggest challenge faced by many organizations today is to decide whether to implement a new software system or re-engineer the legacy system. Irrespective of the decision, agile methodologies are the best suitable for both types of projects i.e. new software as well as the software re-engineering project.

Software re-engineering projects are no different from new software development projects except in that there is already a working legacy system and extra care should be taken while implementing and releasing new features to ensure that the existing functionalities are not disturbed and the business continuity is maintained. For the same reason, it is equally important to release smaller and more frequent product increments that are easily verifiable in the production environment [10, 11].

Define a product catalogue. Refer to the software re-engineering objectives in order to identify the features to be re-engineered and add them to a product catalogue. Product Catalogue includes a list of features to be delivered/re-engineered along with their priorities and interdependencies.

Determine the stride duration. Ideal stride duration can be anywhere between one week to four weeks. Many agile development frameworks suggest having a fixed stride duration throughout the project but it is a highly subjective fundamental. Ideally, the stride duration should be just good enough to deliver a viable product increment. There is nothing wrong with having different stride durations in one project as long as the deliveries are in alignment with the business needs and the duration is comfortable for the development team to deliver the planned features.

Strides shorter than one week may create a chaotic and stressful environment within the development team as one week is usually too short to develop, test and deliver new or re-engineered features. Especially the re-engineered features require heavy regression testing before they could be released into the production environment. Strides longer than four weeks may introduce a risk of the development team losing their focus from their daily and weekly goals. Frequent and regular product increments also give more comfort to the stakeholders and increase trust and transparency across the organization.

Stride planning. Stride planning is an exercise to define what can be delivered in the stride and how to deliver it. The product owner defines a goal based on the value they seek and the development team determines whether the goal is achievable within the stride duration or not.

Stride catalogue. The stride catalogue is the output of stride planning and it is a subset of the product catalogue. The stride catalogue consists of a list of new or re-engineered features to be delivered at the end of the stride along with their priorities and interdependencies. The development team is assumed to have confirmed the feasibility of delivering all the features listed in the stride catalogue during the stride planning session.

Daily goal. Once the stride catalogue is defined, the development team should determine their daily goals and milestones and work towards achieving them. Achievement of daily goals is a key factor in ensuring that the stride goal is achieved at the end of each stride.

Stride goal. The stride goal is to ensure that all the features listed in the stride catalogue are developed and delivered as per the plan and a product increment can be released at the end of the stride.

Stride appraisal. Once the stride is concluded, an appraisal session should be conducted with the relevant stakeholders to review the work and the product increment that was delivered in the last stride. The development team need to highlight

if any new technical debt was created during the last stride and the product owner should add a new item to the product catalogue to further re-engineer the feature to replay the technical debt in a timely manner. The development team may also propose re-designing or re-development of a feature along with its justification and criticality to help the product owner define the priority of the item and add it to the product catalogue if necessary.

4.5   DevOps and Automation

DevOps and automation are key factors for successful agile deliveries. DevOps is also a culture that seeks to identify novel ways to improve and streamline processes. As a result, DevOps focuses on maximizing efficiency, identifying automation opportunities and increasing automation [8].

Effective use of DevOps ensures continuous integration and continuous deliveries and saves a tremendous amount of time for the development team. Automated testing ensures that development teams don't waste time on manual regression testing and focus on frequent and reliable code changes and deliveries, which is a critical factor for re-engineering projects [8, 12, 13].

4.6   Agile Development Framework for Software Re-engineering

An agile development framework is a specific approach to planning, managing and executing a software re-engineering project to ensure the true agile adoption across the organization to achieve the optimum objectives of continuous integration and continuous delivery [3] (Fig. 3).
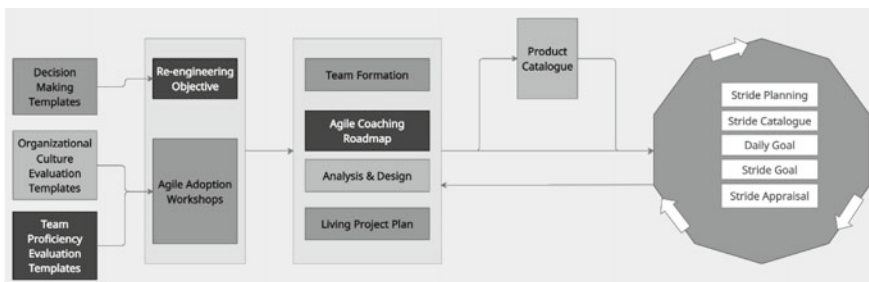
Fig. 3   Agile development framework for software re-engineering

5 Conclusion

Software re-engineering is a continuous and integral part of the product development lifecycle. The agile development framework is one of the most optimum and effective frameworks for software re-engineering projects, however, its adoption can be a bit challenging as it requires a greater amount of organizational alignment combined with a thorough understanding of the software.

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A Comparative Analysis of Fault Detection Techniques for Software Efficiency

Nikita Gupta and Ripu Ranjan Sinha

Abstract Software fault prediction is a crucial and useful strategy for enhancing the reliability and quality of software. The capability to estimate which components of a big software system are almost certainly to have a prime number of defects in the next release provides improved project management, with early prediction of probable release delays, and reasonably leads to remedial measures to enhance software quality. Difficulty in this field is accurately identifying the flawed source code. The task of developing a model for Fault Prediction (FP) is difficult, and throughout history, several solutions have been offered. Recent advancements in machine learning (ML) technology, particularly the development of deep learning (DL) techniques, have enabled these approaches to handle various issues. Nevertheless, building robust fault prediction models is a difficult problem, and several strategy have been presented in the literature. The area of software fault detection and correction is examined in this study. This research also examines many fault detection systems using a table, graph, and image.

Keywords Software fault detection · Deep learning · Machine learning · Software quality assurance

1 Introduction

The emergence of ICT (information and communication technology) has created a notion of a smart factory that is anticipated to revolutionize the industrial sector. To execute smart factories, technology like networks, sensors, robotics, and cloud computing (CC) is essential to boost the adaptability and flexibility of production.

Software Fault Prediction (SFP) models are a key aspect of software quality assurance, used to identify problematic software modules based on measurement data (software metrics) [1]. Modeling for FP is a significant area of study that has been the topic of several previous studies. FP models enable software developers to emphasize

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development efforts on failure-prone code, hence enhancing software quality and optimizing usage of system resources with a high fault probability [2]. The present defect prediction study focuses on three approaches: predicting no. of faults left in software systems, identifying defect connections, and categorizing defect-proneness of software components, often into 2 classes.

Data collection is a major issue in this field. In [3], a single firm supplies the data; hence the findings are not trustworthy. Before 2005, moreover half of the studies used non-public datasets; though, with help of the PROMISE repository, the proportion of investigations using public datasets increased to 50% [4]. The findings are more trustworthy and not peculiar to a certain company. SFPs are characterized by metrics, datasets, and methodologies [4]. According to the literature, SFP methods use method-level and class-level metrics. Class-level metrics are retrieved using the Object-Oriented Programming (OOP) style, whereas method-level metrics are procedural. Compared to other measures, method-level metrics are still most prevalent in FP research and ML algorithms. Researchers have spent years developing machine learning, statistical, and hybrid algorithms.

2 Literature Review

This work [5] presents a charging pile error detection approach that depends upon ELM (Extreme Learning Machine) method. This technique builds data for general aspects of charging piles and creates a classification prediction framework using the ELM algorithm, which is distinct from the conventional charging pile fault detection model. The experimental findings show that frameworks accuracy is 83%, with strong practicability, and high efficiency.

In this study, Ahmed et al. [6] suggested an SFP development model employing ML approaches. They employed tenfold CV, precision, accuracy, f1-score, recall, and specificity to assess the model's performance. This research claims 98–100% classification performance using SVM on 3 defect datasets. This study may help software practitioners and researchers to choose automated tasks for their applications.

In this work, Rathore et al. [7] discussed the SFP technique for 5 eclipse project datasets and object-oriented project datasets and reported study findings. They employed Accuracy, AUC, Specificity, and Sensitivity to analyze the presented methods' performance. A cost–benefit analysis was also undertaken to examine the approach's economic potential. Results revealed that the provided technique successfully predicted software defects with the highest values of 0.816% accuracy, 0.835% of AUC, 0.98% of sensitivity, and 0.903% of specificity. Cost–benefit analysis revealed the strategy might reduce software testing costs.

This work [8] highlights the most prevalent transmission line defects and how machine learning may be used to classify them. The proposed techniques examine the defects with various input combinations and provide an accurate result. Implementation of machine learning techniques is done with Spyder IDE (Scientific

Python Development Environment). This approach is intended to help accomplish the objective.

3   Neural Network Techniques Applied to Fault Detection

The most prominent DL algorithms for SFP are DBN, CNN, LSTM, and RNNs.

3.1   Deep Belief Networks (DBNs)

DBNs are a graphical representation that generates all potential values for the problem at hand. Combining probability, statistics, machine learning, and neural networks. DBNs include several layers and values, yet the layers are unrelated. The goal is to assist the system in categorizing the data.

3.2   LSTM (Long Short-Term Memory) Technique

LSTM Network is an enhanced RNN that stores information. It solves the vanishing gradient issue of RNN. For persistent memory, RNNs are utilized.

The unit is an LSTM block because the software employs a structure that depends on short-term memory processes to build long-term memory. LSTM is a common concept in RNNs.

3.3   Convolutional Neural Networks (CNNs)

A CNN or ConvNet is a network design for DL that learns directly from input, removing the requirement for human feature extraction. CNNs outperform other neural networks using image, audio, or speech signal inputs. They contain 3 main layers that are as follows:

- Pooling layer
- Convolutional layer
- Fully Connected (FC) layer.

1st layer of the convolutional network is the convolutional layer. Though convolutional layers may be followed by other pooling or convolutional layers, the FC layer is the last. Each layer of CNN enhances its complexity, recognizing more of the picture. Earlier layers emphasize fundamental components like colors and edges.

As image input passes through the CNN's layers, the network learns to distinguish more significant components or shapes of an object until it classifies it.

3.4 Recurrent Neural Networks (RNNs)

RNNs may "remember" the network's prior outputs and use them as inputs to subsequent calculations. By integrating loops in the network model, prior steps' data may persist, enabling the network to make wiser decisions. LSTM or GRUs (Gated Recurrent Units) may be added to an RNN to help it recall key facts.

4 Machine Learning Techniques for SFP

SFP predicts which areas of the software are fault-prone. By concentrating on fault-prone files, testers may save time. Several ways have been created to execute SFP, beginning with a basic equation, statistical analysis, expert estimates, and ML. ML has shown to be the finest research-based technique. To automatically forecast the defect prediction module, ML methods are applied. In ML, classification is used. The classification technique involves labeling a new sample depending upon the group of labeled samples. Different ML algorithms are described in this section.

4.1 Support Vector Machine (SVM)

SVM is a method for supervised ML that can be utilized for regression and classification. Nevertheless, this is often applied in classification issues. In the SVM approach, every data item is represented as a point in n-dimensional space (where n is no. of features), with a coordinate value of every feature. After that, we classify by choosing a hyperplane that best separates 2 classes [9].

4.2 RF (Random Forest)

It is an ML approach for classification and regression problems. Ensemble learning combines several classifiers to solve complicated problems.

A random forest method consists of numerous decision trees. RF method trains its 'forest' through bagging or bootstrap aggregating. Bagging enhances ML algorithms' accuracy [10].

4.3 ANN (Artificial Neural Network)

Multilayer Perceptron (MLP) and ANN are popular. MLP can address problems like pattern recognition and interpolation. Two-step reverse propagation is used to train direct-acting neural networks (forward and reverse pass). The pass-forward gave the neural network a voice that would spread [11].

4.4 Naïve Bayes (Naïve Bayesian)

Naive Bayesian is an easy-to-implement classification algorithm. Bayesian classification combines supervised learning and statistical classification. The fundamental technique uses Bayes' theorem, which implies class properties are independent [12]. Naive Bayes has 2 stages: training and prediction.

4.5 KNN (K-Nearest Neighbor) Algorithm

This algorithm, often called KNN or k-NN, is a non-parametric, supervised learning classifier that organizes data points depending on their proximity. It can be utilized for regression or classification, although it is often a classification technique that assumes comparable points are close together.

5 Comparative Analysis of Machine Learning Techniques in SFD

We tested LR (Logistic Regression), RF (Random Forest), NB (Naive Bayes), GBC (Gradient Boosting Classifier), SVM (Support Vector Machine), and ANN (Artificial Neural Network).

This study uses the CM1 dataset, KC1 dataset, KC2 dataset, PC1 dataset, JM1 and ALL DATA failure prediction datasets (KC1, KC2, PC1, CM1, and JM1). Each instance contains 22 attributes, 21 of which may be utilized as features and 1 as a class label for classification purposes. Class distribution of 'Clean' and 'Buggy' classes in the dataset.

The benchmark dataset is obtained from tera-PROMISE Repository.[1]

Figure 1 shows the comparison of ML techniques such as logistic regression, naïve Bayes, gradient boosting classifier, support vector machine, random forest, artificial neural network, etc. using the CM1 dataset. In this bar graph plot, the x-axis

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[1] http://openscience.us/repo/defect/mccabehalsted/.

Table 1 Comparison of neural network and machine learning techniques according to advantages and disadvantages

Techniques	Definition	Advantages	Drawbacks	Ref.
RNN	RNNs are referred to as regular since they do a similar task for each element in a sequence, with the outcome dependent on prior calculations	– Ability to accept inputs of any length – The model size is not proportional to the size of the input – Computation takes historical data into consideration	– Slow calculation – Difficulty gaining access to information from many years ago – No further input may be considered for the present state	[13]
LSTM	LSTM network is a form of RNN model that circumvents vanishing gradient issues by including 'forget' gates	– Retaining information for an extended period	– Training takes longer time – Training demands greater memory	[14]
CNN	CNN is a kind of DNN that replaces matrix multiplication with convolution in at least one of its layers	– It detects significant traits automatically, without human intervention	– Need much training data – High cost of calculation	[15, 15]
DBN	DBN is an unsupervised probabilistic DL algorithm	– Requires just a tiny labeled data set – It is a solution to the issue of vanishing gradients	– It disregards application structure information	[17]
Logistic Regression	LR represents the data and explains the relationship between a binary dependent variable and independent factors	– Easily implementable – Efficiently train	– It cannot integrate distinctive features to form new features	[18]
SVM	SVM is a model of supervised learning. It may be utilized for both classification and regression problems	– Using different kernel functions produces a more accurate prediction result – Less processing capability	– Unsuitable for a vast majority of software metrics	[19]

represents the number of machine learning techniques, and the y-axis represents the accuracy rate in percentage for each technique. As we can see in the comparison graph, the gradient boosting classifier gave the best accuracy in comparison to the other machine learning techniques.

The early identification of faulty (buggy) and clean modules increases quality improvement operations and overall quality. Figure 2 represents the graphical comparison of various machine learning techniques and a dataset that is used in this comparative paper. This figure shows the sensitivity of all 30 classifiers sorted by ML technique.
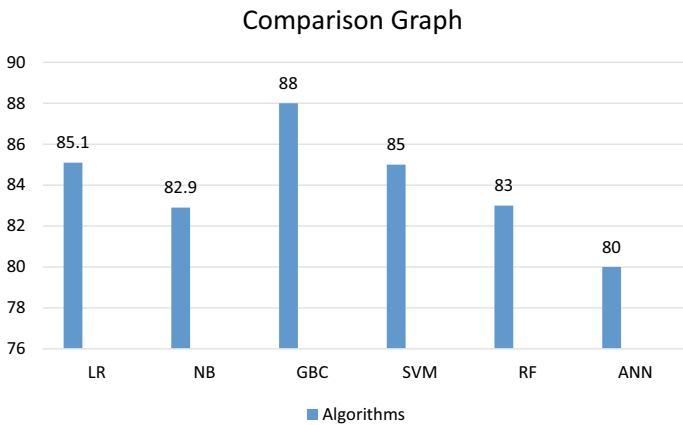
Fig. 1 Comparison of ML techniques using CM1 dataset

Fig. 2 Graphical comparison of various ML methods and datasets
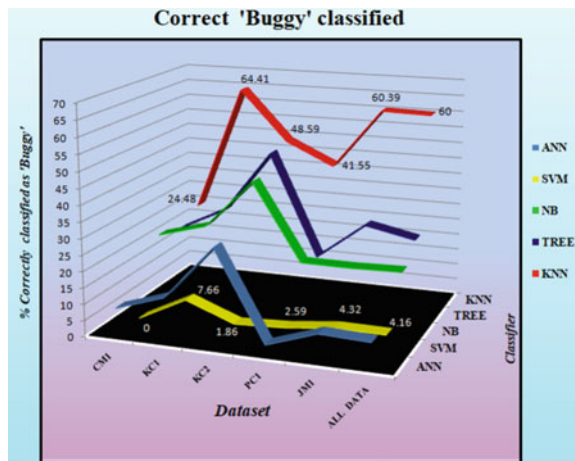
6   Conclusion

With contemporary software's rising size and complexity, software reliability assurance has become a formidable obstacle. To improve software dependability, we believe that detecting future code faults in software implementations is a positive step that has the potential to decrease the software maintenance effort significantly. This study provides a comprehensive review of Machine Learning (ML) and neural network approaches for SFP. This comparative evaluation found that the gradient boosting classifier had outperformed in terms of accuracy and also obtained 88% accuracy. However, all machine learning techniques have performed well by achieving above or equal 80% value, and the best values for logistic regression are 85.1, 82.9% for naive Bayes, 85% for support vector machine, 83% for the random forest, and 80% for artificial neural network, respectively.

Fault management in modern applications is in its infancy, and the solution design strives to provide as much tolerance as possible. More models and strategies are required to enhance the fault detection and rectification procedures and activities.

Moving forward, we expect that further research could improve our model by investigating more parameter tuning and constraints. Moreover, except for ML techniques, search-based methods can also be used for model development.

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PUF Based Security for the Physical Hardware Devices of IoT Using White-Box Cryptographic Technique

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Abstract Hardware security for IoT systems has always been a concern to establish trust among its users and till now it doesn't meet its reliable outcome, though many solutions are provided also. Using physical unclonable functions with WBC as a solution to secure the embedded firmware of the IoT device hardware gives a nominal level of security. To provide the solution to these issues, our approach gives the solution by implementation of White-Box AES cryptographic technique that can be integrated with the physical unclonable function (PUF) based key generation, this dynamic hash-key will be used to encrypt the firmware of embedded hardware as well as for device authentication which makes IoT devices more secure and reliable on SOC.

Keywords Internet of things · White box cryptography · Hardware security · Physically unclonable functions

1 Introduction

Internet of Things is capturing the global market, WSN gives the ease of collaboration between the several various devices and equipment to communicate all together, giving platform for creation of different types of smart intelligent devices as this can satisfy the most requirements with low cost and the experience of rapidly developing solutions, offering a creative and versatile environment with ease of remote communication, but for all these devices their security mechanism is quite an expensive for IoT in terms of energy consumption and processing overheads. The aim is to ensure that these wireless communications devices [1] give both energy efficiency

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and robustness. We now consider Low-power Lossy Networks (LLNs) implementations for potentially important system scenarios (e.g. Manufacturing plant control, industrial automation), requiring both reliability and security assurances. There are three main security standards that any technology project needs to focus majorly while designing it: Confidentiality, Integrity, and Availability, known as the CIA. We should take more responsibility for IoT security loopholes [2] as they are introduced in major sectors such as nuclear power plants, hospitals, industries, and many.

CyberAttacks are the huge concern to establish trust among the industries or cities which are evolving and upgrading to become more smarter. Most of the people are targeting the security from the perspective of software and networks but what if the intruder access the hardware and takeover the control that will create more critical situation for the management, which motivates us to bring some focus towards the hardware based security features which is more adaptable and accepted amongst SOC based companies who are finding solutions to tackle this kinds of threats.

Physical unclonable functions which are used to implement security on the hardware can be utilized but there are always some loopholes while implementation. PUF can be implemented on the hardware but the key utilized for implementation will be hardcoded inside the hardware itself for faster performance. That was the reason the fully implemented security was not able to be established and several researchers are finding a way to generate it. Here comes the idea of implementation of PUF using White-Box Cryptographic approach.

WBC is becoming the most popular approach in the recent decade amongst the researchers for developing the security for hardware, as we see there might be similarity between the idea behind WBC & techniques used for obfuscation that is nothing but a dead end to do reverse engineering for extraction which are best defense available for white box attacks [3]. Whereas an obfuscated WBC algorithm makes it stronger when implemented. In addition we get an advantage to implement WB cryptographic algorithms along with its key with the proof that adversaries attacks won't be enough to extract the key from the hardware device. Making public-key encryption with the help of secret-key for device level Authentication & PUF key obfuscation using WBC techniques.

2 Review of Literature

Delgado in [4] they proposed a very interesting solution by proposing Behavioral-PUF, the algorithm which is used to improve the properties of SRAM PUFs. Babaei [5] have performed a good review on PUF challenges and provided some of the solutions like FPGA-based PUFs will be used to improve the security in IoT, hence we can improve it more by using cryptographic methodologies. Gao et al. have proposed the light weight solution for authentication mechanism using PUF [6]. Beunardeau [7] has already provided the idea behind the AES based security but total AES or DES based implementation was not yet made. R. Wallrabenstein [13] proposed PUF-based algorithms; they have provided the theoretical idea on the authentication of
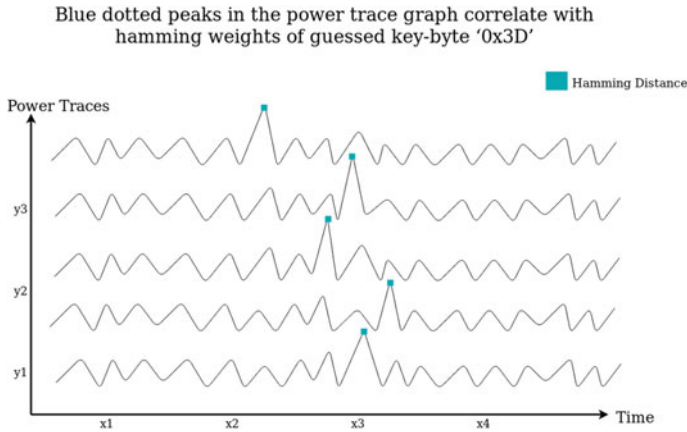
Blue dotted peaks in the power trace graph correlate with hamming weights of guessed key-byte '0x3D'

Fig. 1 Extraction of sub-keys in WBC

IoT devices and decryption of data using PUF. W. Yu and S. Köse proposed AES implementation for securing IoT devices on grey-box attack technique on correlation power analysis [14]. Mutual authentication mechanism [15] based on the multi-key can establish the secure session is proposed for IoT device authentication by T. Shah and S. Venkatesan.

The below technique shown for Correlation Power Analysis (CPA) and Differential computation analysis by software based extraction of dynamic binary instrumentation using tools is proposed by Nihal Pasham for exploiting the fixed-keys in WBC techniques [16] (Fig. 1).

2.1 Identified Gap

See Table 1.

Table 1 Comparison of methods

Technique	Attacks possible	Key type	Inferences
PUF	Machine learning, CPA	Fixed key	PUF can overcome the authentication of IoT devices but cannot be applied on other problem for hardware like securing intellectual property
Light-weight AES	CPA, DCA	Fixed key	Encryption techniques can be used to secure the data on the hardware, but the key of the algorithm is totally exposed on the hardware
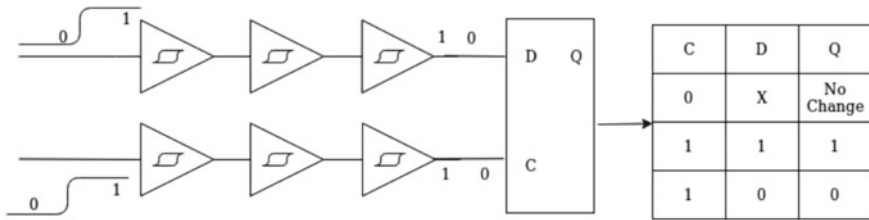
Fig. 2 How PUF works

3 Research Methodology

3.1 Physically Unclonable Functions (PUF)

The whole concept of PUF is based on the manufacturing of any semiconductor for any hardware, monitoring the variations which happen naturally. Therefore it is to be implemented in IC's of any hardware device that is required to provide a good level of security. To give an alternative to cryptographic techniques, PUF has its own CRP (Challenge-Response Technique) (Fig. 2).

3.2 Applications of PUF

Physical unclonable function [8] is a normal function which gives a physical hardware a unique characteristic in such a way that its cloning is practically impossible. In this paper, we have tried to apply some mathematical formulation to represent the functionality of PUF_i:

$$X_j^i = PUF_i(Y_j)$$

$X_j^i \in \{0, 1\}^\lambda$ will be the response of PUF_i based on the given challenge $Y_j \in \{0, 1\}^r$, r will be totally dependent on the type of PUF applied & λ will be the security key. With all this understanding we came up with some properties available in Reliability, Uniqueness, Unpredictability, Tamper-evidence. Reliability is because if we apply the same PUF twice to the given Y_j the correlation of hamming distance for the responses to λ will be at its most t, i.e., $\frac{HD\left(X_j^i, X_j^i\right)}{\lambda} \leq$ t. Uniqueness is because if we apply two different PUF then both will result in different responses, the correlation of hamming distance for the responses to λ will be at least u, $\frac{HD\left(X_j^m, X_j^n\right)}{\lambda} \geq$ u. Unpredictability uses the applied previous properties to PUF_i as a challenge, $Y = \{Y_j | j < n\}$ and its correlated responses like $X^i = \{X_j^i | j < n\}$ so due to this the probability of prediction of X_n^i is almost neglectable. Response of λ-bit can

Fig. 3 Applications of PUF
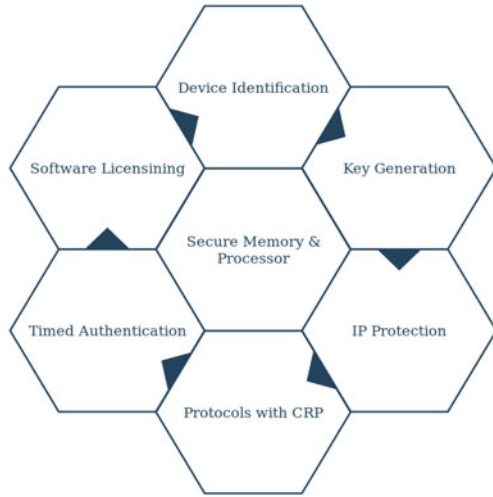
be predicted by the previous known CRPs if the p percent will be at most, i.e., $\mathrm{Pp}(X_n^i|X_j^i : j < n) < p$. Tamper-evidence is a totally observable phenomenon because any physical tampering of PUF will lead to change in the behaviour of its challenge and response (Fig. 3).

Note: To make the challenge-response of PUF to be deal, which is mentioned above then the values of PUF, t, u and p will be equal to 0, $\frac{1}{2}$, and 0 respectively.

3.3 White-Box Cryptography

The given below figure provides a basic understanding of WBC for high-level implementation of a fixed key. The key would be embedded hard-coded into the IoT device for an implementation. The outline of an encrypted cipher and the key are on the left hand side. White-box transformations will then produce the code for an algorithm that is contextually the same but for which the key that is encoded in the code is difficult to extract (Fig. 4).

Using the concept of WB-cryptography ultimately we focus AES implementation and its consists of C_r rounds, and $C_r = 10$ for AES-128 bit.

The basic single round of WB-AES consist of 4 parts but before entering to any of first round of SubBytes, we have AddRoundKey, in this step we generate key-customized instance of AES-128 and that will be integrated to SubBytes to create a huge lookup table of (8 * 8 * 10) 160 each per round, i.e., $E_{m,j}^n$.

$$E_{m,j}^n(y) = \mathrm{S}\left(y \oplus k_{m,j}^{n-1}\right) \text{ where, } m = 0, \ldots, 3, \ j = 0, \ldots, 3, \ n = 1, \ldots, 9.$$
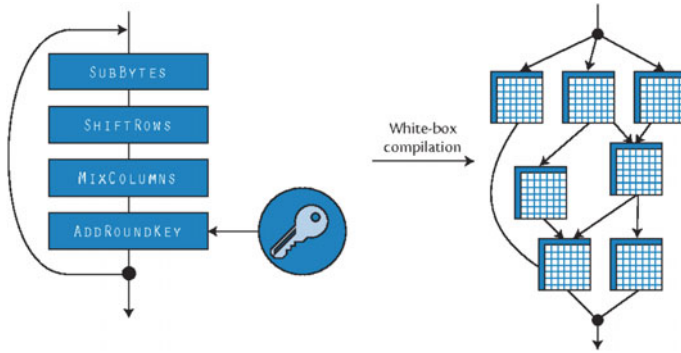
Fig. 4 Basic flow of WBC-AES [7]

The 8 bit mapping of S-box for AES and its sub-key $k_{m,j}^n$ will create E-SubBytes from the previous AddRoundKey.

For the last 10th round it will be: $E_{m,j}^{10}(y) = S(y \oplus k_{m,j}^9) \oplus k_{sk(m,j)}^{10}$.

Where $sk(m, j)$ will be a new location of the cell for ShiftRows and MixColumns is omitted for the current implementation step.

3.4 Proposed Idea

The cryptic algorithm (cipher) can be implemented by input data D and the key that is generated by PUF X_n^i, we need to set the key size 2^{128} block.

For random key generation in PUF based implementation, we need 128 flip-flops to generate the LFSR.

$$X_n^i = y^{128} + y^{126} + y^{101} + y^{99} + 1$$

Basic Idea for generating cipher:

$$C(D, K) = O, \ K = X_n^i$$

With this approach we can totally secure the key based cryptographic implementations for IoT devices and the possibility of extracting the key from the device will be impossible.

We are proposing a dynamic-key implementation for WBC encryption process, every time the device will boot the new key will be generated and this approach overcomes the flaws found in fixed-key implementation of WBC. When dealing with these

embedded devices that are very necessary for Industries 4.0, health industry and automotives [17] we found the two major areas which are considered as a problem in physical level security [18]. The authentication of IoT devices & security of intellectual property.

4 Analysis Conducted

Based on the study conducted, there are several protocols which can be implemented for physical layer hardware based solutions in IoT in terms of authentication, encrypted data generation and security of firmware.

4.1 Authentication of IOT Devices

The early protocols which will be using NVM which is non-volatile memory for CRP or while generating challenge and response they use lightweight cryptographic hash for the generated response. Mutual authentication protocols follow the authentication mechanism [9] in two levels of checks one was with device to server level authentication and the second one was device to device level authentication but not enough for the ML attacks. Obfuscated CRP which doesn't require the cryptographic primitives since it was robust against ML attacks [10] but however it doesn't provide mutual authentication because it is limited to the IoT devices against servers. Last one is lockdown protocol which provides the mutual authentication between device to servers but not to the second phase which is device to device (Fig. 5).

Fig. 5 Authentication mechanism followed in PUF
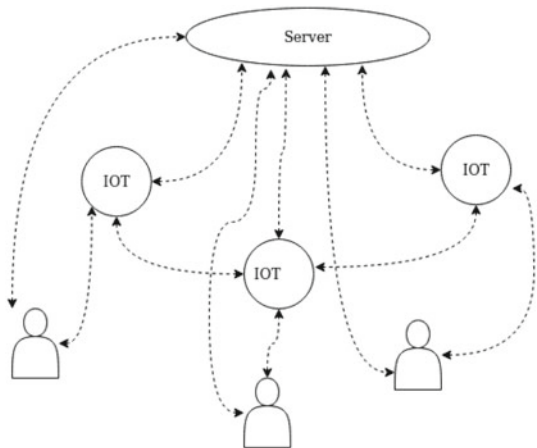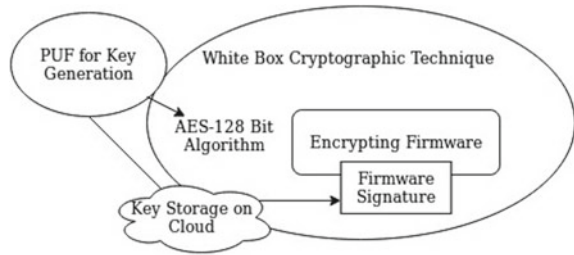
4.2   Firmware Security in IOT Devices

The whole idea lies within the Crypto-Engine which will be the region where the
actual hardcoded algorithm will be available and embedded for faster processing
whereas the encryption key will be designed using PUF technique into the hardware
itself, if the device hardware is exposed to intruder, then integration of the key will not
be possible, Random number [11] can be used to create the key or digital signature
which is considered as the root of trust for every firmware, whereas key must be
stored on the cloud server for mutual identification of IoT devices (Fig. 6).

5   Conclusion

After studying many available solutions we tried to investigate the puf-based
key generation for authentication of IoT devices and the generated key used for
encryption-decryption using AES based WBC technique. There are many researchers
and companies trying to implement the solutions through lightweight crypto tech-
niques in hardware based security [12] but the strong proof is not yet developed due
to which we tried to give some idea to implement a WBC technique with dynamic
key generation using PUF, it will be almost difficult to capture the subkeys as the
whole mechanism depends on dynamic key generation, which is full fledge cross
layer solution to two problems discussed for hardware attacks on IoT devices.

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A Review on Authentication Schemes for the Internet of Drones

Muskan Sharma , Bhawna Narwal, and Richa Yadav

Abstract Internet of Drones (IoD) is the newly emerging field of IoT. Over the years, various advancements in IoD have attracted the attention of researchers and engineers. It has very promising applications in various fields like smart city, military, education, medical, industries, etc. Drones being a critical part of IoD have also evolved over time. So, they are equipped with sensors and high-resolution cameras, providing better data with increased accuracy and precision. But, with growing popularity and advancements, they are prone to many security attacks. Day-to-day, the IoD environment faces many attacks like man-in-the-middle, impersonation, drone capture, node tampering, modification, replay, eavesdropping, cloning attack, etc. Hence, there comes a need for authentication schemes that authenticate the network entities before communicating the data. This paper reviews some of the latest authentication schemes on the basis of their network models, proposed scheme, advantages and disadvantages. These schemes work on similar or different network models, but ensure that basic security requirements of the IoD environment are fulfilled. Moreover, along with a comparative report of these existing schemes, a brief about various formal proofs used by these schemes to verify the security of their scheme is also given.

Keywords Internet of drones · Security · Authentication

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1 Introduction

Over the years, we have seen great advancements in various fields ranging from agriculture, and military to industries. The backbone of these advancements is technology comprising newer and more efficient hardware and software designs. In this development, IoT has received significant attention. Internet of Things (IoT) or a network of connected devices gathers huge chunks of data from the environment, stores it and analysis it [1]. This information can then be used in various applications.

Internet of Drones is a recent encroachment in the field of IoT. Similar to IoT, it consists of a network of connected devices where the key role is played by drones. Drones are the ones in direct contact with the environment, they scan, store and deliver the information to fulfil a requirement. Figure 1 represents various applications of IoD.

Drones are an important part of smart city designs. IoD ensures efficient traffic surveillance and real-time notifications, which provides assistance using accidents. Climate monitoring is another benefit that helps in analyzing the environment and provides information about temperature, humidity, rainfall, etc. In rural areas as well, IoD proves to be extremely helpful. Like in the case of agriculture surveillance to look after crops, their regular watering etc. [2].

Along with never-ending applications and advantages, IoD has several security challenges. Since the whole network runs wirelessly, adversaries can attack the communication paths and cause damage to the network.

Various attacks like man-in-the-middle, replay, denial-of-service, etc. occur when an unauthorized person/entity gets access to the network.

Hence an authentication mechanism is very essential in any IoD environment.

An adversary can capture the messages being communicated in the network and then attempt to impersonate an authorised network entity, to affect other entities in the network. Also, drones are prone to drone capture attacks since they are remotely
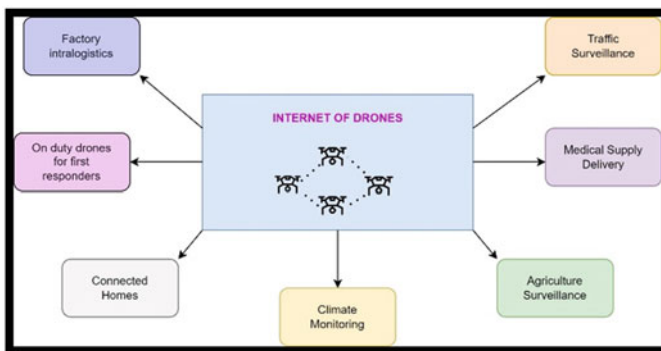
Fig. 1 IoD applications

allocated. And due to the low storage and computational power of drones, there is a need for secure and lightweight authentication schemes.

Over the years, many authentication schemes are proposed with regard to the above-mentioned concerns [2–7]. Researchers have come up with innovative and efficient methods to propose authentication schemes. They have used hash functions, XOR operations, elliptic curve cryptography (ECC) and concatenation operations. Recently, with advancements in technology, schemes have used blockchain and physically unclonable functions (PUFs). Blockchain is basically a chain of blocks, and these blocks are immutable and they store shared information.

They virtually keep track of all the assets of the network. Whereas, the PUF provide a unique fingerprint to every drone, helping in uniquely identifying the drones. It is based on a challenge-response pair. A PUF will generate a response for a challenge passed to it which will be completely different from other PUFs gone through the same fabrication process.

The main objective of this paper is to review the existing authentication schemes for IoD environment. The paper is organized as follows. In Sect. 2, an overview of IoD environment and its network model is discussed. The section also highlights the basic security requirements and formal proofs of an authentication scheme. Section 3 depicts a comparative report of the recent authentication schemes proposed in the field of IoD. Then, the final conclusion along with future scopes is given in Sect. 4.

2 IoD Overview, Requirements and Proofs

2.1 Overview

Internet of Drones (IoD) is a network of drones or Unmanned Aerial Vehicles (UAVs) deployed and controlled by a central authority that is usually named the Ground Station.

These drones are deployed in some remote locations and work on limited battery power. They extract specific information from the environment and transmit it to the ground station or user. Drones are composed of various sensors and high-resolution cameras to collect efficient data. This whole big network and process of transmitting information need to be protected from various security threats. Over years, several security complications have arisen. For example, establishing session-key agreement, authentication, resistance to attacks, and privacy.

A typical network model of IoD is shown in Fig. 2. It contains the entities that are key participants in any IoD environment.

These network entities are as follows:

- **Ground Station (GS)**: It is the central authority of the network. It contains all the databases and secret information about the whole network. It first registers the drones and then allots them to a particular remote location. In case, a user wants

Fig. 2 IoD network entities
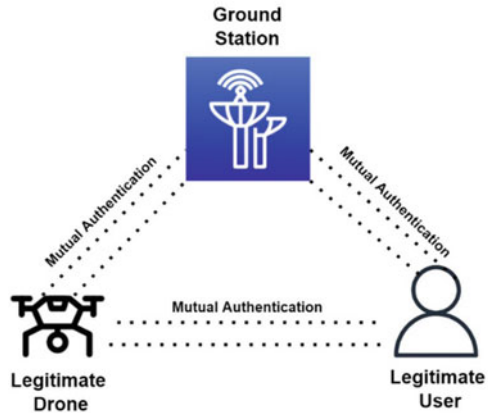
to connect with the drone, GS acts as an intermediate. It first authenticates the user and then assigns a drone to it.

- **Drones**: They are the key entities of the IoD environment, they are responsible for getting the most essential part of IoD network, i.e. data. Once deployed, they use their sensors and cameras to capture the required information from the environment and then transmit it to GS or the user.
- **Users**: They are the ones who use the data collected by drones. They can connect with the drone via GS and obtain the required information.

Before establishing the network, drones are registered on the GS and similarly, interested users get themselves registered. Then, in any session, before transmitting data, every entity validates each other using an authentication scheme. In case, any condition in the authentication scheme is not fulfilled, the connection is not established and information is not transmitted.

2.2 Requirements in IoD Environment

Hence, it is essential to design a secure authentication scheme in order to protect the IoD network from any possible attacks. The basic security requirements for an authentication scheme are:

- **Anonymity**: It ensures the identity of sender and receiver remains unknown.
- **Untraceability**: Any message communicated should not reveal anything about the sender and receiver.
- **Mutual Authentication**: Every entity should authenticate that the incoming request is from a legitimate entity. Once confirmed then only it takes respective action.

- **Integrity**: It signifies that the received message remains unmodified and intact. Anonymity and Untraceablity together ensures integrity.
- **Session-key Agreement**: It requires a session key to be established between the user and drone before exchanging the information so that the information remain protected.

2.3 Formal Proofs

After a rigorous review of various authentication schemes, it seems along with fulfilling the above basic requirements, the proposed scheme should also exercise some formal proofs in order to verify its security. There are various proofs being defined over the years like ROR Model, coding simulations, BAN Logic, Boyd etc. But, in this paper, we will review three widely used formal proofs and those are BAN Logic [9], AVISPA Simulations [11] and ROR Model [10].

These are briefly described as follows:

- **BAN Logic**: It is a formal proof that defines certain rules and identities. In order to prove a particular scheme ensures key agreement and mutual authentication, it should pass these rules.
- **AVISPA Simulation**: AVISPA is a software to test cryptographic protocols. All the entities present in the network are represented using objects in code. And respective message communications also need to be coded. Then, on running simulation, it tells whether a particular scheme is safe or not.
- **ROR Model**: It is the most used Model for verification purposes. It actually verifies the security of the session key. It also contains a theorem that is to be proved by exercising certain games. These games are assumed to be played by the adversary in a compromised situation.

3 Comparative Report for Existing Authentication Schemes in IoD

Table 1 shows a brief comparison between the various schemes in terms of the proposed scheme, network model, advantages and disadvantages.

Wazid et al. [3] proposed a scheme for mutual authentication between user and drone. They used hash-function, XOR operations along with fuzzy extractor method. Their scheme is composed of 7 stages. The first stage is a pre-Deployment stage, in which GS generates a unique ID for the drone and stores it in its database with other information. Whereas the drone also stores its ID, GS ID and other information in its memory. Then comes, the user registration stage, for user to be able to access the drone from anywhere, it sends its ID to GS, and GS then creates a pseudo-identity for the user. A fuzzy extractor is used for biometric verification, once the password is

Table 1 Authentication schemes comparison

Ref.	Year	Network model	Proposed scheme	Pros	Cons
[3]	2018	Ground station server, drones, user, control room, Internet	Proposed a secure scheme based on one-way hash-functions and XOR operations using random nonces and timestamps	– Lightweight – Lower cost requirements – Ensures forward secrecy – Security against man-in-middle and replay attacks	– Prone to privileged insider attack – Prone to cloning and node-tampering attacks – Lacks basic security requirements
[4]	2019	Ground station server, drones, user, control room, Internet	Lightweight authentication scheme using one-way cryptographic hash-function and fuzzy extractor	– Ensures three-factor authentication (smart card, password and biometric) – Lightweight – Balances trade-off between storage and cost needs	– Prone to known session key attacks – Prone to cloning and node-tampering attacks
[5]	2020	User, Drone, Ground Station	An authentication Scheme based on creation of session key between user and drone using only one-way hash-function and XOR operations	– Security against impersonation, man-in-middle and replay attacks – Ground Station is secure against server proofing attacks	– Prone to cloning and node-tampering attacks
[6]	2020	Drone, Ground Station	A lightweight authentication scheme for mutual authentication between drone and ground station using only one-way hash-function, XOR operations and PUFs	– Ensures security against cloning and node-tampering attacks – Lightweight – Ensures mutual authentication between network entities	– No formal proof is used to confirm security of scheme – Less practical model
[7]	2021	Ground station server, drones, user, control room, Internet	An authentication Scheme for user-drone communication based on ECC, passwords and biometrics	– Ensures session-key agreement – Ensures security against impersonation attacks – Ensures security against password guessing and lost/stolen user device attacks	– Prone to cloning and node-tampering attacks

Table 1 (continued)

Ref.	Year	Network model	Proposed scheme	Pros	Cons
[8]	2021	User, Drone, Ground Station	An authentication scheme proposed using biometrics, passwords, ECC, random numbers, timestamps, cryptographic one-way hash-functions and XOR and concatenation operations	– Ensures all basic security requirements – Secure against man-in-middle, replay and impersonation attacks – Secure against drone capture attack – Secure against modification attack – Secure against password guessing and lost/stolen user device attacks	– Prone to cloning and node-tampering attacks – AVISPA simulation not used for security verification – High-cost requirements

chosen by the user. The exchanged information is stored safely in GS and the user's device memory.

Then, in login phase, user inputs his ID, password and biometric and computations are run to verify the user. If the calculated value matches the stored value, user is authenticated else session is terminated and the login fails. Then, comes the authentication phase, where user first runs certain computational expressions consisting of hash functions and XOR and concatenation operations. And directs certain messages to GS, GS first valid the user and then generates new messages to direct to drone. Similarly, drone validates the incoming messages using stored information in its memory, once verified, drone computes the session key. And directs certain messages to user so that user can also compute the session. It is only when each entity validates the incoming message, it performs further computations. Hence, mutual authentication is ensured.

Last three steps are: Password/Biometric updation, through which user can update his/her password or biometric by first verifying the existing password/biometric, then generating new ones; Dynamic Drone Addition Phase, through this drones can be dynamically be added to IoD network and Drone Key Management, in case two drones need to communicate with each other.

From a security perspective, this scheme is resistant to various attacks like man-in-the-middle, replay, stolen smart device, modification and offline/online password guessing attacks. Moreover, AVISPA Simulations show that this scheme is safe against adversary attacks in a real-life IoD environment.

Srinivas et al. [4]'s proposed scheme also works on the same network model and it consists of 6 stages: pre-deployment, user registration, login and authentication, password/biometric update, revocation and reissue and dynamic node addition. Here, drones are deployed in clusters called flying zones. The first four stages are similar

to [3]. Stage 5 is helpful in case, user's smart device is lost or stolen, the user can contact GS with same ID but different password and the process repeats and the new mobile of the user becomes part of IoD network. This scheme seems quite promising as it overcomes attacks like Known Session Key, modification, impersonation, etc. The security of [4] is proved by ROR Model and AVISPA simulation.

Zhang et al. [5] propose a lightweight authentication scheme using just 4 stages: the set-Up stage, user registration, drone registration and authentication phase. It is centric to establish a key-agreement between user and drone. In the set-Up stage, GS creates a pseudonym for itself and chooses a secret key. Then in user registration, interested user conveys his/her ID and password to GS to get a pseudonym and secret key. GS after certain computations creates a pseudo-identity and pseudo secret key for the user which is visible to the public. Both these things are stored in user's device memory and GS also stores this information with respect to user. A similar thing happens between GS and Drone in the drone registration phase. In authentication phase, Zhang et al. [5] doesn't use anything apart from hash functions and XOR (and concatenation) operations. This is a very effective scheme as apart from resistance against cloning and node tampering attacks, it provides security against impersonation, known session key, modification and many more attacks. Its security is ensured by ROR Model.

Alladi et al. [6] propose a very lightweight authentication scheme with a slightly different network model, it consists of only GS and drones. And it ensures providing mutual authentication between drone and GS as well as between two drones. For implementing the scheme, Alladi et al. [6] uses basic hash functions and XOR, concatenation operations. It uses the latest technology of Physically Unclonable Functions (PUFs) [12–16] which protects the scheme in case of cloning and node tampering attacks. PUF basically assigns uniqueness to every drone. It comprises a challenge-response (C-R) pair, so for every C, there will an R as output. And this R will be unique for every drone given with the same C. PUF has the property that in case, an adversary tries to tamper with the drone, this PUF will be completely unusable and hence adding an extra layer of security to the information stored in the drone's memory.

It assumes that drones have limited storage and power supply whereas GS has unlimited storage and power supply since GS is stationary and drones are in remote locations. It includes three stages: Drone registration, Drone-GS authentication and Drone-Drone Authentication. The drone registration phase is somewhat different from the above-discussed schemes as it uses PUF. So, GS generates a C-R pair for the drone along with a temporary ID. GS stores this information for the drone and the drone stores C, GS ID and its temporary ID.

Then, the authentication process starts post-registration, where R plays the key role. Using substrings of R, XOR, concatenation and hash-functions, a lightweight scheme is proposed with a communication cost of 1600 bits and storage cost of 352 bits. For, Drone-Drone communication, first Drone A authenticates with GS and then GS authenticates Drone B and provides a session key for both drones to communicate with each other. This scheme is resistant to various attacks like eavesdropping, replay,

man-in-the-middle, etc. The security of the scheme is also proved by formal proof of Boyd Logic followed by informal cryptoanalysis.

Hussain et al. [7] proposes an Elliptic curve cryptography (ECC) based authentication scheme for the network model that contains Drones, users, the Internet, Ground Station Server, and Control Room. This scheme is also focused on securing the user-drone communication through computational authentication. It contains around 6 stages. First is the set-Up phase, where GS decides the Elliptical Curve and a base point and announces them publically. Then, in the pre-deployment phase, pseudonym or pseudo-identity is calculated for drone and is stored in its memory. Then a user, who wants real-time data from the data, needs to register with GS. For registration, both password and biometric security are used. Now comes the authentication stage, user first inputs his/her user ID and password and then convey some messages to GS so that GS can validate the user. GS follows the same flow, first verifying the user then computing messages that are to be conveyed to drone. Once, drone receives the messages and verifies them, it generates a session key and sends encrypted messages to user so he/she can also generate the session key. Once, the session key is created by both user and drone, session-key agreement is ensured. The last two steps are biometric/password updation and dynamic drone addition which are already discussed above.

Ali et al. [8] the proposed scheme consists of 4 steps: initialisation, registration, login and authentication and password update. Its network consists of user, drone and ground station. The setUp phase is implemented by GS by selecting a master key and computing the pseudonym for itself. GS uses this master key to compute pseudonyms for users and drones as well. Then, the registration of user and drone is similar to [4] and it uses hash functions, XOR and concatenation operations.

The registration happens via a secure channel whereas the authentication phase happens via a public channel so this scheme like all other schemes makes sure to use pseudonyms in transmitting messages instead of real identities. For password updation, it is interesting to note that user don't require connecting with GS, instead, he/she can do it at their own end.

No matter what technologies are being employed in creating the authentication scheme, its important to fulfil basic security requirements. So, Table 2 shows the comparison based on security requirements.

4   Conclusion and Future Scope

In this paper, recently proposed authentication schemes for IoD were reviewed. A comparative report was provided to emphasize their proposed scheme, network model, advantages and disadvantages. The comparison showed us that every scheme tried to balance the trade-offs and there is no perfect solution. Moreover, since security is a major concern in the IoD environment, the schemes were compared on the basis of security requirements fulfilled. In the coming future, we will get to see more

Table 2 Comparison based on security requirements

Ref.	Anonymity	Untraceability	Mutual authentication	Integrity	Session key agreement
[3]	−	−	−	−	−
[4]	−	−	+	−	+
[5]	+	+	+	+	+
[6]	+	+	+	+	+
[7]	+	+	+	+	+
[8]	+	+	+	+	+

+: Supported; −: Not Supported

secure schemes with much higher security and the incorporation of advanced technologies like machine learning and artificial intelligence to make IoD even more robust.

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An Exhaustive Sentiment and Emotion Analysis of COVID-19 Tweets Using Machine Learning, Ensemble Learning and Deep Learning Techniques

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Abstract COVID-19 has been generating new variations one after the other and there is no end to it. Even though vaccines are out, the cases are skyrocketing after each day while the number of deaths has increased simultaneously. In these crucial times, it is necessary to build a system which can aid in making the situation controlled by taking the necessary actions. There are number of ways available to deal with this situation and it is very much essential to highlight those different steps which can help not only in the advancement of technology but also will replenish the goal of thinking different when any pandemic strikes again, if at all, in the future. The main purpose to carry out this research is to exhaustively understand the 3 sentiments (positive, negative and neutral) as well as 11 emotions (Optimistic, Thankful, Empathetic, Pessimistic, Anxious, Sad, Annoyed, Denial, Surprise, Official report, Joking) of public towards COVID-19 pandemic. 5000 COVID-19 related tweets were collected from Twitter and different perspectives such as government policies, safety measures, COVID-19 symptoms and precautionary measures were considered for sentiment analysis as well as emotion detection task which was performed using 12 different models. These models were categorized as baseline models, ensemble learning models and deep learning models. Results revealed that ensemble learning models outperformed baseline and deep learning models for sentiment analysis task. Highest accuracy 60.1% was reported by Gradient boosting algorithm. For emotion analysis task, baseline category performed better as compared to ensemble and deep learning models. Finally, Multinomial Naïve Bayes was reported as the winning algorithm.

Keywords COVID-19 · Deep learning · Emotion detection · Ensemble learning · Machine learning · Sentiment analysis

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1   Introduction

The coronavirus pandemic gave horrific scenes to the crowd around world in the years 2020 and 2021. As there were no vaccines or medicines, which can cure the symptoms of the virus, the different Governments took various measures which were not formal in their own ways but kept its place [1, 2]. Various precautions included quarantine, lockdown, self-isolation, safe distance, and many more which by some extent reduced the havoc which shook the whole world.

This was one part of the whole situation going around in the world, well the other half was occupied by activists, political leaders, the people itself, media and many more. But the major part was occupied by social media. Nowadays, Social Media has become a key to express positivity around, but it also leads to negative impact when the information is quite accurate or satisfy the human mind and so does it happen in the COVID -19 pandemic, where number of news and rumors were communicated across the Social Media platform, making people excited and happy when they see a tweet or a post which relieves them from the pain of virus itself and also at the same time making people sad and more panicked when they see something which is unimaginable. So, there was a need where posts, tweets etc. get a proper segregation which can define whether that particular post will make a healthy impact on the readers' mind or will give a shocking impact.

The main purpose of this research work is to perform emotion detection and sentiment analysis of tweets over COVID-19. To carry out this work, various machine learning, ensemble and deep learning methods are used for extracting emotion based sentiments from tweets. The paper is organized as follows. Section 2 presents related work carried out in proposed direction. Complete methodology followed for implementation of this work is presented in Sect. 3. Detailed results and analysis are presented in Sect. 4 followed by conclusion in Sect. 5.

2   Previous Work

This section presents previous reported work carried out in this direction. Table 1 presents approach and feature based analysis of various works carried related to sentiment analysis of COVID-19.

From Table 1, it can be observed that number of different techniques (including supervised and unsupervised) were experimented to identify sentiments related to COVID-19 from different social media platforms. Figure 1 depicts the pictorial distribution for different approaches used. From machine learning (ML) area, prominent algorithm usage is for Support Vector Machine (SVM), Naïve Bayes (NB) and Logistic regression (LR) [3–5]. Deep Learning (DL) techniques such as Long short term memory (LSTM), Bi-directional Encoder Representations from Transformers (BERT) and Bi-directional Long Short Term Memory (Bi-LSTM) were used by many researchers [6–9]. Other techniques used by different researchers include

Table 1 Approach and feature based analysis for COVID-19 sentiment analysis

Year	Approach used	Feature used	Performance/outcome	Ref.
2021	MLP	Bag of word	83%	[6]
2021	GSOM	Word2vec	Negative emotions	[10]
2021	LDA	–		[11]
2021	LSTM, Bi-LSTM	Bag of word	90.59%, 90.83%	[6]
2021	Bernoulli NB, SVM, LR	VADER based sentiment score	85.95%	[3]
2021	LSTM, Bi-LSTM, BERT	Bag of word	49%, 58%	[7]
2021	LDA	Bag of word	73% (RNN)	[12]
2021	Lexicon based Kruskall-Wallis test	Bag of word	p-value < 0.0001	[13]
2021	Lexicon based	Bag of word	Positive sentiment	[14]
2021	Bi-LSTM	GloVe	89.51%	[15]
2021	LDA	Bag of Word	Vaccine hesitancy among users	[16]
2021	BERT	–	87%	[8]
2021	Clustered based	–	98%	[17]
2021	NB	Bag of word	81.77%	[4]
2020	LDA	Bag of word	Positive emotions	[18]
2020	LR	–	78.5%	[5]

unsupervised learning (US) techniques, Latent Dirichlet Allocation (LDA), Multi-layer Perceptron (MLP), Growing Self-organizing Map (GSOM) and lexicon-based (LB) Natural Language Processing (NLP). These techniques were implemented for extraction of emotions and sentiments from COVID-19 text on different social media platforms. Figure 2 presents the average based performance analysis of existing COVID-19 sentiment and emotion detection analysis works.

Dataset based analysis was provided in Table 2. Sentiment and Emotion detection analysis for COVID-19 related text was carried in different perspective such as false

Fig. 1 Different approaches used for COVID-19 sentiment analysis
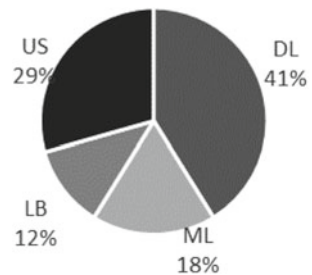
Fig. 2 Performance analysis of existing COVID-19 sentiment analysis works
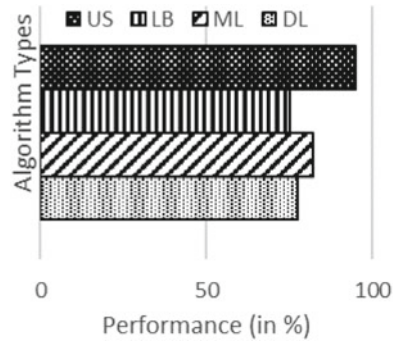
news during COVID-19, COVID-19 related awareness, COVID-19 vaccination opin-
ions, COVID-19 and political perspective, public response to COVID-19 and many
more. Time span considered for COVID-19 analysis is March 2020 to May 2021.
Figure 3 depicts that much of sentiment analysis work was carried during first wave
of COVID-19. Language of majority of tweets is English. From reviewed literature,
it can be concluded that for sentiment analysis task, main class labels used are posi-
tive, negative and neutral whereas for emotion detection task, main class labels are
fear, sadness, anger, disgust and optimistic.

3   Methodology

Architecture of proposed methodology is depicted in Fig. 4. Proposed system consists
of two main phases: phase 1 and phase 2. The detail description of phase 1 and phase
2 is presented in Fig. 4.

3.1   *Phase 1*

It consists of the following sub phases.

3.1.1   Data Collection and Understanding the Dataset

For this research work, we have utilized admission dataset from Kaggle [5]. Dataset
comprises of 5000 tweets which were further divided into categories and sub cate-
gories. For sentiment analysis of COVID-19 related tweets, tweets were bifurcated
into positive, negative and neutral tweets. For emotion detection related to COVID-
19 pandemic, 11 different labels were selected. This sub categorization includes:
Optimistic (0), Thankful (1), Empathetic (2), Pessimistic (3), Anxious (4), Sad (5),

Table 2 COVID-19 dataset analysis for sentiment analysis task

Ref.	Description	Source	Volume	Duration	Class count	Language	Location
[12]	Vaccination	Twitter	125,906	December 20, 2020 to July 21, 2021	3	English	Across world
[13]	Leader's response on COVID-19	Twitter	15,848	January 1, 2020 to December 21, 2020	2	English	United Kingdom, Canada, New Zealand, America
[14]	Sentiment analysis	Twitter	150,000	March 2020 to September 2020	5	English	India
[15]	Public sentiments	Twitter	4511	February 1, 2020 to August 31, 2020	3	English	Singapore
[16]	Sentiments about vaccination	Twitter	701 891	December 1 2020 to March 31, 2021	2	English	Across the World
[10]	Sentiments about vaccination	Twitter	4 million	January 2020 to January 2021	3	English	Across the world
[8]	Emotion detection about COVID-19	Twitter	5,60,14,158	March 5, 2020 to December 31, 2020	10	English	USA
[17]	Public Opinion about COVID-19 vaccination	Reddit	18,000	December 1, 2020 to May 15, 2021	2	English	Across the world
[3]	Emotion Detection	Twitter	73,000	January 2020 to September 2020	8	English	Australia

(continued)

Table 2 (continued)

Ref.	Description	Source	Volume	Duration	Class count	Language	Location
[9]	Emotion detection about COVID-19 vaccination	Twitter	928,402	–	4	English Turkish	USA, UK, Canada, Turkey, France, Germany, Spain and Italy
[18]	Sentiment analysis	Twitter	0.3 million	Before March 20, 2020	3	English	Across the world
[6]	Sentiment analysis	Twitter	70,000	–	3	English	Nepal and Italy
[19]	Public response to the COVID-19 pandemic	Twitter	4 million	March 7, 2020 to April 21, 2020	5	English	Across the world
[7]	Sentiments Relating to COVID-19 Vaccination	Twitter	–	January 2020 to October 2020	8	English	Australia
[11]	Sentiment related to COVID-19 vaccination	Twitter	993	March 1, 2021 to March 31, 2021	3	English	Philippines
[4]	Sentiment analysis	Twitter	50,000	January 2020 to July 2020	2	English	Across the world

Fig. 3 COVID-19 sentiment analysis time span
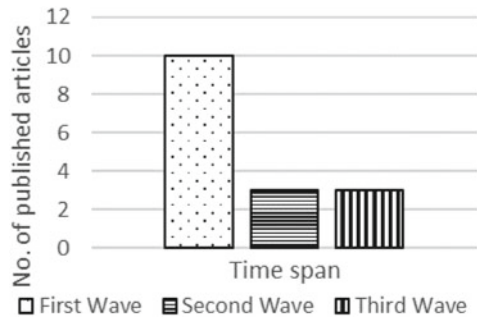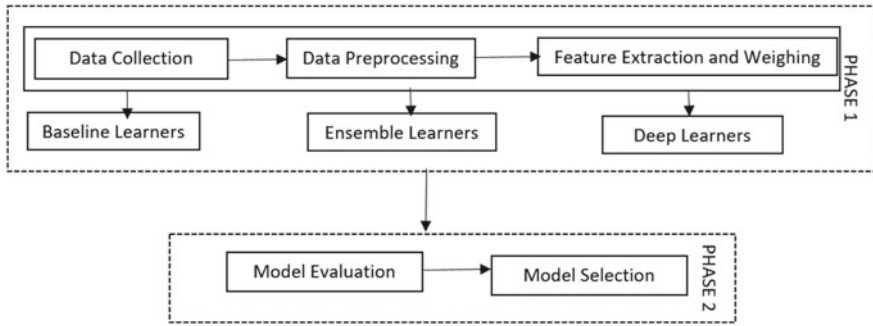
Fig. 4 Architecture of COVID-19 sentiment and emotion detection system

Annoyed (6), Denial (7), Surprise (8), Official report (9), Joking (10). Statistical analysis of the dataset is provided in Table 3.

Figures 5 and 6 show the distribution of dataset (in categories and sub categories). Basic experimental analysis was performed to understand human emotions in 3 polarities, i.e., positive, negative, and neutral; our findings showed that 28% of people were positive, 52% were negative, and 19% were neutral, in response to COVID-19 worldwide. Emotion based classes distribution was presented in Fig. 6. Out of 10 emotion labels, prominent distribution of tweets was present in optimistic (23%), annoyed (17%), sad (13%), anxious (11%).

Table 3 Dataset description

Dataset	Total tweets	Total words	Average tweet length
COVID-19	5000	51,388	10.27

Fig. 5 Sentiment class distribution in dataset
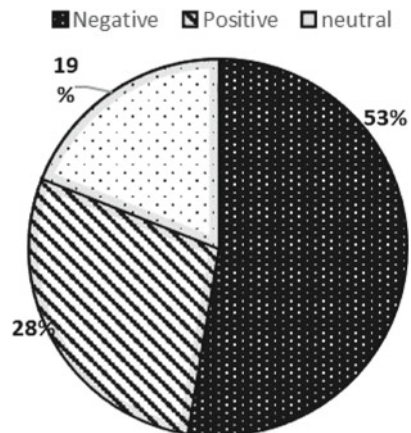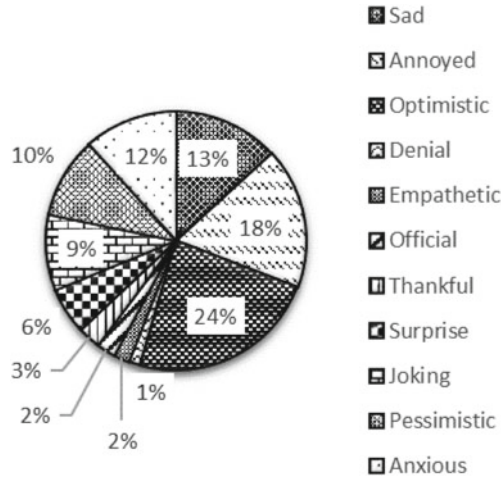
Fig. 6 Emotion class distribution in dataset

(a) Negative	(b) Positive	(c) Neutral
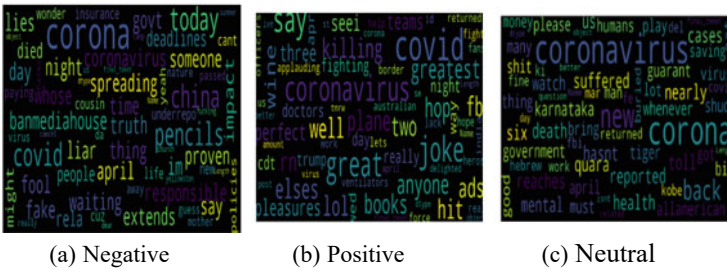
Fig. 7 Word Cloud for 3 sentiment analysis class labels

For better understanding of dataset, word analysis was carried out. Top words in each category of sentiment (positive, negative, neutral) were presented in Fig. 7. Table 4 presents the top-5 words present in each.

3.1.2 Data Pre-processing

All tweets were passed through various pre-processing phases:

1. Removing Numbers, Special Characters and Punctuations

Punctuation marks, numbers, and special characters are not helpful in analyzing emotions. It is best to remove them from the text. Here we will replace everything except letters with spaces.

Table 4 Top 5 words in each emotion class label

Sub category	Top 5 words
Optimistic	Coronavirus, Covid, great, joke, doctors
Annoyed	Corona, pencils, coronavirus, Covid, China
Pessimistic	Corona, virus, world, American, temperatures
Surprise	Coronavirus, death, cases, new, India
Sad	Coronavirus, life, corona, bat, government
Joking	Corona, coronavirus, April, virus, neighbours
Anxious	Corona, enough, medication, critical, effects
Thankful	Health, therapy, perfect, greatest, books
Empathetic	Please, corona, coronavirus, joke, end
Denial	Diagnostics, China, deaths, long, bioweapon
Official	God, internet, virus, natural, elaborate

2. Stopwords Removal

In NLP work stopwords (very common words e.g., that, are, have) do not make sense in reading because they are not connected with emotions. Removing them therefore saves integration and increases the accuracy of the model.

3. Stemming using Porter Stemmer

Stemming is used to remove the suffixes such as ('-ing', '-ly', '-es', '-s', etc.) to get a root word of some particular word specified. We implemented Porter Stemmer in our work. We have used five step process, all with its own rules. Porter Stemmer is renowned because of its easy-to-use behavior, speed and efficiency. The outcome will get us a word in its root form.

4. Label Encoding of target variables

This is an encoding which converts the categorical values in integer values in between the range of 0 and the number of classes minus 1. If suppose, we have 5 distinct categorical classes, then the conversion would be (0, 1, 2, 3, 4).

3.1.3 Feature Extraction and Feature Weighing

After pre-processing of data, 'Bag of Word' model is used for feature extraction and vector space representation was created for entire data. Term frequency (TF) and Term-frequency inverse document frequency (TF-IDF) is used for feature weighing.

3.1.4 Model Training

In total, 12 models were trained and tested on this dataset. Based on their type, these models were divided into three categories: Baseline Learners (BL), Ensemble

Learners (EL) and Deep Learners (DL). Baseline learners consists of Logistic Regression (LR), K- Nearest Neighbour (KNN), Support Vector Machine (SVM), Multinomial Naïve Bayes (MNB) and Decision Tree (DT). LR, NB (& it's variation), SVM are statistical models in nature. LR is a way of modeling probability of a discrete outcome given an input variable [3, 5]. NB is based on conditional probability and Bayes theorem [3, 4]. SVM perform classification by finding a hyperplane that distinctly classifies the data points [3, 4]. Ensemble Learners consists of Random Forest (RF), XG Boost (XGB), Bagging (BG) and Gradient Boosting (GB) [20]. RF operated by constructing multitude of decision tree. XGB uses gradient boosting technique to generate boosted tree with enhanced performance. BG aggregates the performance of several weak models. GB tries to minimize the loss function by adding weak learners using gradient descent. Deep learners consist of Artificial Neural Network (ANN), Convolutional Neural Network (CNN) and Long Short-Term Memory (LSTM) [6, 7. ANN is nonlinear statistical model which exhibits the complex relationship between input and output. CNN is a class of deep neural network which consists of an input layer, an output layer and numerous hidden layers. LSTM is one type of recurrent neural network that records different cell state to perform the classification.

3.1.5   Phase 2

Performance evaluation is carried out using Accuracy, Precision, Recall and F1-measure [21].

4   Results and Analysis

This section provides the result and analysis of the application of 12 algorithms on two feature weighing criteria (TF, and TF-IDF) and on sentiment analysis as well as emotion detection tasks.

4.1   Result and Analysis on Sentiment Analysis

4.1.1   Sentiment Analysis Results Using TF

From Table 5, it can be observed that, with accuracy of 59.1%, precision of 64.9%, recall of 46.3% and F1-score of 47.3%, SVM performed better as compared to other baseline algorithms followed by Multinomial Naïve Bayes. Among ensemble learning methods, gradient boosting turns out to be the best with accuracy, precision, recall and F1-score of 60.1%, 63.1%, 48.2% and 49.5%, respectively. It can be observed that with highest accuracy, precision, recall and F1-score (34.9%, 54.0%,

Table 5 Results of algorithms using term frequency as feature weighing

Type	Model	Accuracy	Precision	Recall	F1-score
Baseline learners (BL)	LR	59.3	57.0	51.4	52.9
	KNN	52.8	49.7	39.3	36.7
	SVM	59.1	64.9	46.3	47.3
	MNB	59.0	56.3	50.6	52.0
	DT	52.3	46.9	46.0	46.3
	Average	56.5	55.0	46.7	47.0
Ensemble learners (EL)	RF	57.5	56.0	46.5	47.5
	XGB	59.3	58.3	47.8	48.9
	BG	58.4	56.6	48.2	49.4
	GB	60.1	63.1	48.2	49.5
	Average	58.8	58.5	47.7	48.8
Deep learners (DL)	ANN	20.9	49.4	98.0	64.6
	CNN	34.9	54.0	81.5	64.3
	LSTM	19.8	47.9	99.6	64.8
	Average	25.2	50.4	93.0	64.6

81.5% and 64.3%, respectively), CNN turns out to be the best among deep learning methods.

4.1.2 Sentiment Analysis Results Using TF-IDF

From the Table 6, it can be observed that, with an accuracy of 59.3%, precision of 66.5%, recall of 46.2% and F1-score of 47.1%, SVM performed better compared to other baseline learners followed by Logistic Regression. From ensemble learning category, gradient boosting has become the best among the ensemble learners. Accuracy, precision, recall and F1-score in gradient boosting were reported to be 58.8%, 58.9%, 47.1% and 48.2%, respectively. CNN turns out to be the best among the deep learners.

Figure 8 indicates that ensemble learners performed better as compared to other ones. Performance of TF and TF-IDF is approximately equal for sentiment analysis task. **From review of existing state-of-art research carried out in this direction (as represented in Table 1), ensemble learning techniques have never been applied for sentiment as well as emotion detection work**. Deep learners were not suitable for sentiment analysis task. Analysis based on other performance metrics (Precision, Recall, F1-Score) are presented in Fig. 9.

Table 6 Results of algorithms using TF-IDF as feature weighing

Type	Model	Accuracy	Precision	Recall	F1-score
Baseline learners	LR	59.2	63.8	46.8	47.9
	KNN	58.0	59.2	46.2	47.2
	SVM	59.3	66.5	46.2	47.1
	MNB	57.5	74.9	41.1	38.2
	DT	50.8	45.2	44.3	44.5
	Average	57.0	61.9	44.9	45.0
Ensemble learners	RF	57.6	55.5	44.8	44.9
	XGB	57.3	62.4	43.1	42.6
	BG	56.9	55.4	46.8	48.0
	GB	58.8	58.9	47.1	48.2
	Average	57.7	58.1	45.5	45.9
Deep learners	ANN	20.8	48.9	96.0	64.1
	CNN	33.3	53.0	88.7	62.9
	LSTM	19.7	47.5	97.6	64.2
	Average	24.6	49.8	94.1	63.7
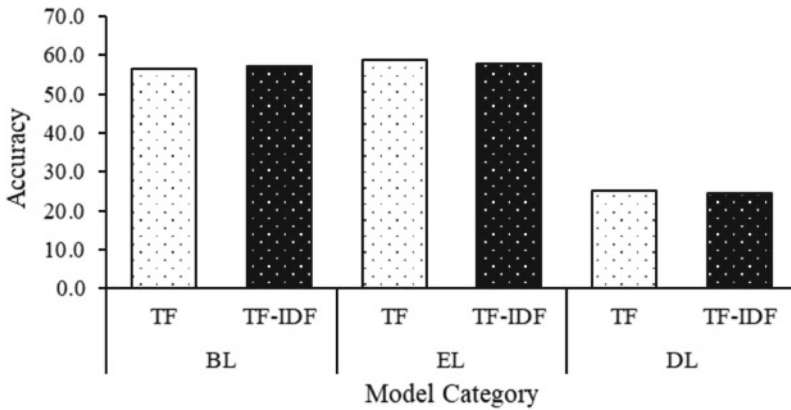
Fig. 8 Average Accuracy based analysis of COVID-19 related sentiments
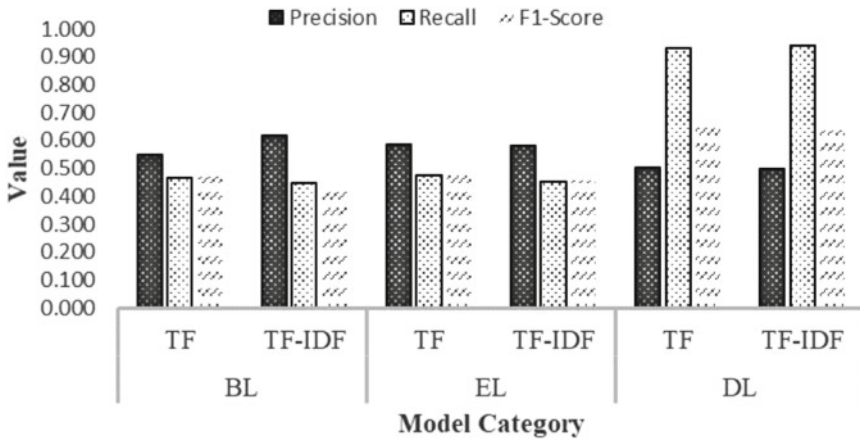
Fig. 9 Average Precision, Recall, F1-Score based analysis of COVID-19 related sentiments

4.2   Result and Analysis on Emotion Detection Task

4.2.1   Result and Analysis Using TF

From Table 7, it can be seen that the MNB, XGBoost and CNN are best performers in BL, EL and DL categories respectively. The best accuracy, precision, recall and F1-scores are respectively 37.5%, 29.4%, 24.5% and 22.6% (for MNB), 36.3%, 47.4%, 26.0% and 28.8% (for XGBoost) while 20.2%, 85.4%, 82.5% and 89.7% (for CNN).

4.2.2   Result and Analysis Using TF-IDF

From Table 8, it could be seen that SVM, with accuracy, precision, recall and F1-score of 35.1%, 37.3%, 21.1% and 19.2% respectively, accomplished better compared to BL algorithms. XGBoost, with accuracy, precision, recall and F1-score of 35.2%, 37.0%, 23.0% and 22.9% respectively, was best in EL category. Also, CNN was best in DL category. Accuracy (Fig. 10), precision, recall and F1-score (Fig. 11) for CNN was reported to be 18.7%, 92.2%, 89.4% and 87.8% respectively.

5   Conclusion

Average Precision, Recall, F1-Score based analysis of COVID-19 related emotions Social Media is platform for expressing your opinions, viewpoints, thought freely without any hesitation. During COVID-19 pandemic, world was physically disconnected due to COVID-19 restrictions but it is more connected in virtual environment.

Table 7 Results of algorithms using term frequency as feature weighing

Type	Model	Accuracy	Precision	Recall	F1-score
Baseline learners	LR	35.9	30.6	25.7	25.6
	KNN	24.9	15.5	18.7	15.9
	SVM	34.8	36.9	20.9	19.1
	MNB	37.5	29.4	24.5	22.6
	DT	27.3	20.8	19.3	19.4
	Average	32.1	26.6	21.8	20.5
Ensemble learners	RF	30.2	29.1	22.0	22.3
	XGB	36.3	47.4	26.0	28.8
	BG	31.6	36.4	20.0	26.9
	GB	32.3	34.8	24.3	26.7
	Average	32.6	36.9	23.1	26.2
Deep learners	ANN	11.6	83.7	99.7	90.4
	CNN	20.2	85.4	82.5	89.7
	LSTM	12.0	83.7	97.5	91.0
	Average	14.6	84.3	93.2	90.4

Table 8 Results of algorithms using TF-IDF as feature weighing

Type	Model	Accuracy	Precision	Recall	F1-score
Baseline learners	LR	37.1	35.6	23.3	22.3
	KNN	34.5	35.9	24.4	23.6
	SVM	35.1	37.3	21.1	19.2
	MNB	32.3	20.3	17.5	14.4
	DT	24.4	22.2	18.8	19.6
	Average	32.7	30.3	21.0	19.8
Ensemble learners	RF	29.3	22.7	19.1	17.9
	XGB	35.2	37.0	23.0	22.9
	BG	30.7	28.4	21.4	21.6
	GB	31.4	27.3	21.1	21.3
	Average	31.7	28.9	21.2	20.9
Deep learners	ANN	11.7	85.1	96.7	90.7
	CNN	18.7	92.2	89.4	87.8
	LSTM	11.1	82.7	98.4	90.5
	Average	13.8	86.7	94.8	89.7
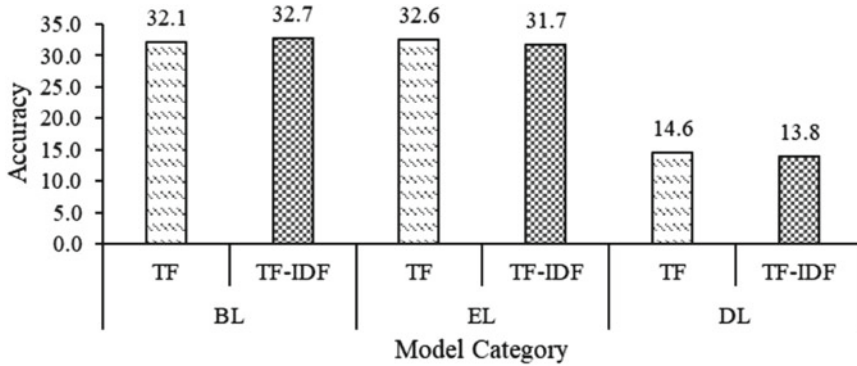
Fig. 10 Average Accuracy based analysis of COVID-19 related emotions
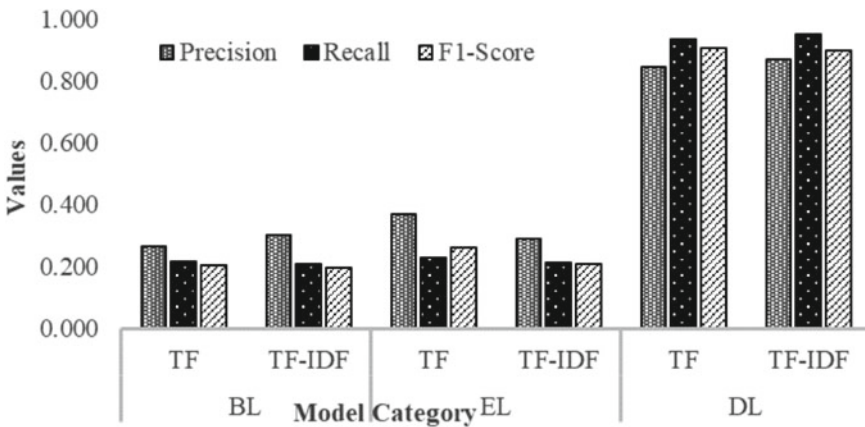
Fig. 11 Average Precision, Recall, F1-Score based analysis of COVID-19 related emotions

This research work was carried on corona virus outbreak using twitter data. The main focus of this study is to understand emotions and sentiments of people during COVID-19. This work helps to understand the people's perception about coronavirus and its impact on the public. The sentiments and emotions during the period were downloaded and the public's reaction towards the outbreak was analyzed. This dataset was passed through various pre-processing phases. Term frequency and term frequency-invers document frequency was used for feature extraction and feature weighing. To analyze sentiment and emotions, total 12 models were trained and tested using twitter dataset. These models were categorized into baseline, ensemble and deep learners. Results revealed that for sentiment analysis task, gradient boosting algorithm with term frequency as feature weighing (from ensemble learning models) outperformed all other models. Accuracy and Precision reported by gradient boosting model is 60.1% and 63.1%, respectively. For emotion detection task, Multinomial

Naïve Bayes model with term frequency performed better in comparison with other models.

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Detection and Categorization of Machine Translation in Indian Languages

Deepti Chopra, Latika Kharb, and Deepak Chahal

Abstract India is a land of diverse cultures and religions consisting of twenty-two different Indian languages that are morphologically rich. Translation of languages is required when people visit foreign lands and for communication of their ideas and thoughts to the people living in that country. Nowadays, when Information Technology rules the world, machine translation is a very crucial term. Today, many machine translators are available online but if a translation of one Indian language to another language is to be performed, it's not up to the mark. In this paper, we have surveyed the available machine translators that are available online today, we have also discussed how the existing translators produce poor quality of translation- the Named Entities are not translated properly, complex/lengthy sentences result in poor quality of translation. So, at this stage machine translation requires extensive training to be performed in terms of sentence rewriting or converting complex and lengthy sentences to simple sentences and named entity translation needs to be performed before conversion of input text into translated text.

Keywords Machine translation · Named entities · Source text rewriting · Named entity translation · Statistical machine translation

1 Introduction

Today, when e-learning has replaced the traditional way of learning, language has become an important medium to convey one's thoughts and ideas. Machine translation begins with the transformation of text from one language to another. The

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translation concept begins when intermediate human translators assisted people in understanding thoughts and ideas and also translated their thoughts and ideas to others when people visited foreign countries. Smart cities have transformed rural cities into advanced ones with the help of AI technology [1]. Today, technology has revolutionized everything. AI has imparted human-like intelligence in all machines. Translation has been a task of great interest for the last sixty years when translation by human translators has been replaced by a machine. The journey of machine translation (MT) has not been so easy. This field has seen many rises and falls, some fake promises and some which were never delivered. Even today, MT plays a very crucial role in understanding the thoughts and beliefs of people from different cultures. After sixty years of research, MT is still an open research problem. After World War II, when the first electronic computer in the US was introduced; MT came into being. Initially, the Translation was performed using manually designed lexical rules and electronic bilingual dictionaries. To make an advancement in the growth of MT, the US Government invested too in the field of MT. After a few years of euphoria, there was a decline in the progress of MT. This led to the formation of a committee called ALPAC (Automatic Language Processing Advisory Committee). ALPAC suggested investing more in basic research in NLP. There are many NLP-based resources (e.g. knowledge base, corpora, tools, etc.) that have been developed that help developers in solving MT-based problems by decomposing the large problem into small subproblems which can then be solved easily. Today, many companies and organizations have incorporated MT into business and have started investing money in MT-based projects. With a rudimentary set of rules for selecting or eliminating some of the possible meanings, better results may be obtained [2]. Figure 1 depicts the levels of linguistic analysis using the Vauquois triangle. There are three methods of linguistic analysis namely, the Direct Method, the Transfer method, and the Interlingual Method [3]. In the Direct Method of MT, translation of source text takes place by word to word translation. In EBMT method, we make use of a bilingual corpus of parallel texts. SMT uses the Bayes decision rule and statistical decision theory to minimize errors in decision-making.

In Interlingua Machine Translation System, an intermediate representation called Interlingua is constructed which is then transformed into the target text. The notion of

Fig. 1 Levels of linguistic analysis using the Vauquois triangle
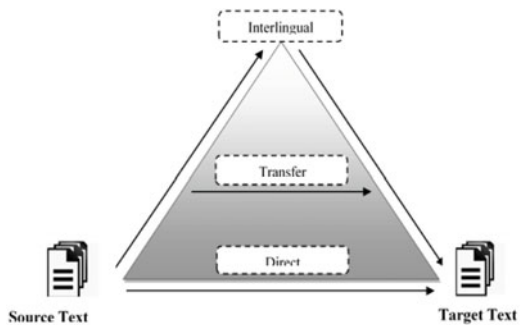
"quality" in Machine Translation (MT) can have different interpretations depending on the intended use of the translations (e.g., fluency and adequacy, post-editing time, etc.)

2 Machine Translation in the Indian Context

Machines were made in history for reducing human labour but now in recent civilizations machines serve the dual purpose resulting in reducing manual and mental labour both for humans [4]. Applications of AI are in medical and healthcare, Expert systems, computer vision, pattern recognition, image processing, etc. For proper communication to take place, there is a need for an expert system that can perform inter-language translation [5]. Some of the Machine Translation Systems established in India are:

2.1 Anusaarka

Anusaarka project was started in 1995 by Prof. Rajeev Sangal and the team at IIT Kanpur. Anusaarka system performs MT from Telugu, Bengali, Kannada, Marathi, and Punjabi to target text in Hindi. It ensures translation from the source text to the text which is very close to the target text without loss of any information. Post edition of the output is performed by the trained user to obtain grammatically correct target text. It fails in interpreting general world knowledge.

2.2 Mantra MT System

Machine Assisted Translation Tool (MANTRA) was developed in 1999 at C-DAC, Bangalore. It can translate text in English into Hindi. The Mantra System was started with English to Hindi text conversion of administrative documents such as notifications, circulars, and appointment letters. It makes use of Lexicalized Tree Adjoining Grammar (LTAG) for representing text in English and Hindi. In Mantra, the lexicon or grammar is limited to a particular domain.

2.3 Matra MT System

The Matra MT system was developed in 2004 by CDAC Mumbai. This project was supported by TDIL. It is a human-aided MT tool for the translation of news stories from English to Hindi. Matra MT System uses different dictionaries based on various

news chosen as an input. This system is also capable of converting complex English sentence into simplified English sentence which is then translated into Hindi. This system is also used in Cross-Lingual Information Retrieval (CLIR) tasks. It is used for general purpose domain. It may lack in lexicon for specific domain.

2.4 AnglaBharati MT System

The anglabharti project was started at IIT, Kanpur in 1991 that can perform English-Indian languages translations. The first prototype of this system was constructed in 1991 for English to Tamil translation and then later English to other Indian languages translations were built. AnglaHindi is the English to Hindi translation version of AnglaBharti and is web-enabled. To perform English to 12 Indian languages translation, AnglaBharti Mission for the development of Machine Aided Translation (MAT) system has transferred AnglaBharti technology to eight organizations such as IIT Mumbai, IIT Guwahati, CDAC Kolkata, CDAC Pune, CDAC Thiruvananthapuram, Thapar Institute of Engineering and Technology, Patiala, Jawaharlal Nehru University (JNU), Delhi and Utkal University, Bhubaneshwar. This MT system would lack in lexicon used for particular domain translation.

2.5 AnuBharti MT System

AnuBharti was developed in 2004. This system involves a combination of corpus-based and example-based approaches. AnuBharti-II has been developed to use a generalized example base and it performs the translation from Hindi to other Indian Languages. This MT system would lack in lexicon used for particular domain translation.

2.6 Anuvaadak MT System

Anuvaadak 5.0 system was developed by Ms. Anjali Rowchoudhury and the team at Info soft private limited, Delhi. It can perform English to Hindi MT of text and deals with specific domains such as Formal, official, linguistics, agriculture, administrative and technical. This MT system would lack in lexicon or grammar for other domains.

2.7 Shiv and Shakti MT System

Shiv and Shakti are developed jointly in 2004. It can perform English to Hindi translations of the text. It is based on RBMT method and Statistical method. Shiva system is based on Example-based MT. If a user is not satisfied by the output, then the system ask for meanings of words in source language then gives another translation.

2.8 Sampark MT System

Sampark MT System was developed in 2009. This MT system was developed using a hybrid approach for translation of Indian language into another Indian language by combining dictionaries, rule-based algorithms, and various statistical machine learning approaches. This MT system provides translation in only specific 18 language pairs.

2.9 Anubaad Hybrid MT System

Anubaad was developed in 2004 by Dr. Shivaji Bandopadhyay and the team at Jadavpur University, Kolkata. It is a hybrid MT system. It is used for the translation of English news headlines into Bengali. Lack of phrases or substitutions may produce inaccurate translations.

2.10 Tamil-Hindi Machine Aided Translation System

This system was developed at Anna Unversity, KB Chandrashekhar research center, Chennai by Prof. C. N. Krishnan. This system is based on Anusaaraka MT System and it performs the translation of source text in Tamil into target text in Hindi. It produces language specific translation.

2.11 English-Kannada Machine Aided Translation System

It was developed by Dr. K. Narayana Murthy at the University of Hyderabad. This system uses the transfer-based MT method to perform the translation of Government notices. It makes use of UCSG (Universal Clause Structure grammar). This system has been funded by the Government of Karnataka. It produces language specific translation.

2.12 UNL-Based Machine Translation System

The UNL project generates interlingua for the natural languages. It was developed by United Nations University. IIT Bombay is one of the members and is involved in the development of English-Marathi and English-Hindi MT systems using UNL formalism. Using enconverter, text in the source language is converted to UNL based text which is further converted into the target language using deconverter. It produces language specific translation.

3 Problems in Machine Translation for Indian Languages

Computers are being utilized in field in education for many years. In last few decades, research within the field of artificial intelligence (AI) is positively affecting educational application [6]. Since past few years the size of the data is growing extremely at fast rates 10 times faster in growth [7]. Indian languages are a huge collection of word forms, so they are morphologically rich languages. Currently, the existing MT systems for Indian languages don't produce efficient results. Some of the challenges faced in MT in Indian languages are [8, 9]:

(i) *Complex or Compound sentences are not translated correctly*

Text simplification involves transforming complex texts into simpler ones while preserving the meaning. Source sentences that are complex are usually translated incorrectly. So, in our research, we have rewritten the source sentences and simplified them, to improve the quality of MT.

For example, consider a source text:

Subhash Chandra Bose was a great freedom fighter who was also popularly known as Netaji and was influenced by the teachings of Swami Vivekanand.

The above-mentioned complex source text can be simplified or rewritten to obtain the following simplified source text.

Subhash Chandra Bose was a great freedom fighter. He was also popularly known as Netaji. He was influenced by the teachings of Swami Vivekanand.

When we provide complex sentences as an input to the current existing Machine Translators, they fail to obtain a good quality of translation.

Some of the list of Complex English sentences is shown in Table 1.

(ii) *Named Entities are not identified correctly*

NER must be performed irrespective of all domains and natural languages [10]. Part of Speech (POS) Tagging is performed in all the NLP Application. After POS Tagging, NER is performed that identifies Named Entities from unstructured text [11]. The various applications of NER are: Question Answering, Information Extraction, Automatic Summarization, Machine Translation, Information Retrieval etc.

Table 1 List of complex English sentences

S. No.	Complex sentences
1	As she was bright and ambitious, she became manager in no time
2	Although it was very long, the movie was still enjoyable
3	You should take your car in for a service because it's starting to make weird noises
4	I really didn't like the movie even though the acting was good
5	When he got a racquet smashed in his face, everyone laughed
6	Because he was so small, Stuart was often hard to find around the house
7	Her mom came home tired, but she still cooked dinner for her family

[12]. Unknown entities should be handled in Named Entity Recognition (NER) [13]. Machine Transliteration involves mapping phonetic sounds of words in one language into words in another language [14]. During translation, numbers and rare entities are directly copied from source to target text. Machine Transliteration may be implemented using Finite State Transducers.

We have also shown translation of English-Indian Languages sentences using Google Translator and Bing Translator as shown in Figs. 2 and 3.
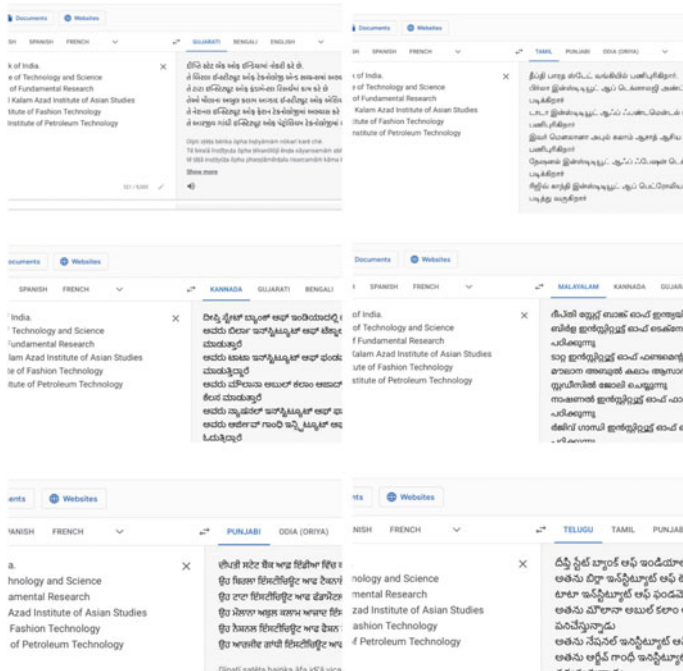
Fig. 2 GoogleTranslation in 10 languages: Bengali, Gujrati, Kannada, Malayalam, Marathi, Odia/Oriya, Punjabi, Tamil, Telugu. Urdu

Fig. 3 Microsoft Bing Translation from English to Bengali
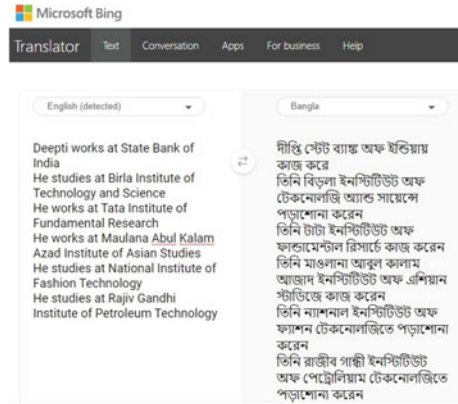
We have considered 1200 sentences and performed Machine Translation for English-Hindi, English-Bengali, English-Gujarati, English-Kannada, English-Marathi, English-Malayalam, English-Oriya, English-Punjabi and English-Sindhi using Google Translator. Accuracy obtained are: 62%, 65%, 65%, 58%, 63%, 61%, 57%, 63% and 61% respectively. This is shown in Fig. 4. Accuracy is calculated on the basis of whether translation in tenses, gender, number etc. is done properly or not. If a sentence is translated properly without any mistake then it is considered as accurate translation otherwise it is treated as in accurate translation.

Quality of translation is defined on the basis of whether all parameters such as tenses, gender, number, active or passive voice etc. have been considered in translation or not.

We have also considered 1200 sentences and performed Machine Translation for Hindi-English, Hindi-Bengali, Hindi-Gujarati, Hindi-Kannada, Hindi-Marathi, Hindi-Malayalam, Hindi-Oriya, Hindi-Punjabi and Hindi-Sindhi using Google
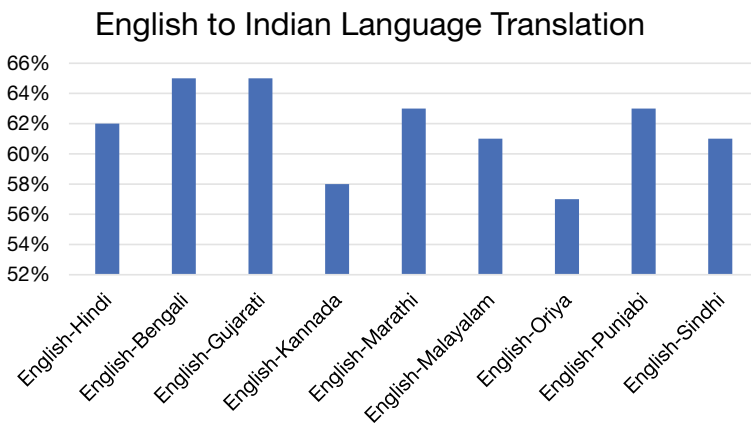
Fig. 4 Result of English to Indian language translation by Google Translator

Hindi to English and Other Indian Languages Translation
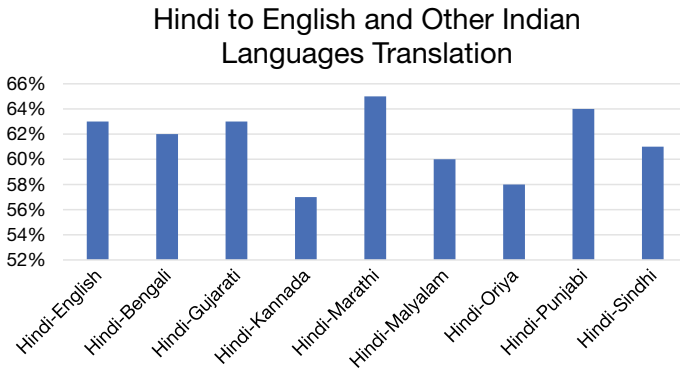
Fig. 5 Result of Hindi to English and Hindi to Indian languages translation by Google Translator

Translator. Accuracy obtained are: 63%, 62%, 63%, 57%, 65%, 60%, 58%, 64% and 63% respectively. This is shown in Fig. 5.

4 Future Scope and Conclusion

We have performed translation of English-Indian Languages and Hindi-Indian Languages using Google Translator. These translations lack in quality. The complex sentences produce low quality of translation. Similarly, Named Entities are not translated properly. In order to improve the quality of MT, if we perform Source Text Rewriting which will convert Complex sentence into Simplified sentence and Named Entity Translation prior to Machine Translation then the quality of Translation for English-Hindi and Hindi-English will improve. We aim to improve our model extending and adding new generator gazetteers [15]. Source text rewriting decreases syntactic and lexical complexity, improves productivity, delivers faster translation while preserving the original meaning of the text. Most people express their views by tweeting their thoughts and perception [16]. Different end users have different requirements [17]. Named Entity Translation correctly identifies Named Entities from the text and then either translate it or transliterate it. In this way, quality of translation for English-Hindi and vice versa will definitely improve.

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A Predictive Framework for Temperature Forecasting Using Machine Learning

Kshitij Sandal, Harsh, and Kavita Pabreja

Abstract Weather forecasting plays a significant role in the economy of a country as it affects various sectors viz. agriculture, tourism, trade, energy, transportation, and utility. Traditionally, the weather parameters like temperature, pressure and wind speed are forecasted by formulating mathematical equations based on observational data gathered by doppler radars, radiosondes, and weather satellites and deploying a Numerical Weather Prediction Model. The major limitation of these methods is that everyone does not have access to high-end equipment for forecasting. With the advent of digital technologies, one can scrape the data from the Internet and plug the data into machine learning models and obtain accurate predictions. In recent times, machine learning models are yielding results of high accuracy. This study provides a comprehensive overview of existing forecasting approaches, ranging from the most basic Moving Average to the more complicated ARIMA and Fbprophet models. The objective of this study is to forecast the temperature based on historical hourly forecasts being fed to numerous machine learning models. Various time series forecasting methods have been experimented with and it has been found that FbProphet performs the best with a root mean square error of 0.087 which is quite convincing and impressive.

Keywords Temperature forecasting · Machine learning · Predictive modeling · Time series · Meteorology

1 Introduction

Weather forecasting is the science of predicting the weather employing physics principles and a combination of statistical and empirical methodologies [1, 2]. An

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accurate temperature forecast is significant for planning various day-to-day activities, farmers need the information to help them plan accordingly for planting and harvesting their crops, also aircraft and ships rely heavily on accurate weather forecasting. Modern weather forecast comprises massive supercomputers, along with the complete forecasting software that helps the meteorologist make weather predictions based on multiple conditions in the atmosphere. The National Oceanic and Atmospheric Administration (NOAA) in the United States and the Indian meteorological department (IMD) in India are the organizations responsible for making public weather forecasts based on periodic measurements.

Until now, the most effective methods for weather modeling have relied on mathematical simulations and the meteorological centers employ a generative model to capture atmospheric dynamics, with samples produced from physical simulations for forecasting purposes. This paper, on the other hand, is based on a data-centric strategy rather than the traditional physical simulation approach to forecasting. Globally, various machine learning techniques that learn from huge collections of data, have been successfully applied for forecasting in numerous application domains viz. stock market, medical science, speech recognition, banking, and finance sectors, etc. The objective of this piece of research is as given below:

1. To investigate the temporal temperature data with the help of various time series analysis methods of machine learning.
2. To train various predictive models on the historic data.
3. To identify the best performing model for temperature forecasting based on performance metric RMSE.

The dataset used in this study is a univariate time series with observation recorded on an hourly basis for temperature. The paper is prepared as follows: Sect. 2 explains the literature review, and Sect. 3 elaborates on the research methodology being adopted that includes data collection, data manipulation, data scaling, and normalization processes. This also includes the machine learning approach and mathematics and statistics behind those techniques. Section 4 discusses the results where the performance of the various methods is examined. Finally, Sect. 5 concludes with the challenges and potential future development.

2   Related Work

Artificial intelligence and machine learning algorithms are becoming more and more popular nowadays. Time series analysis has a surge of interest from data scientists across the globe and has been used in many industries. For example, healthcare industries used time series analysis to evaluate healthcare quality improvements [3]. The prediction of stress levels of students and working professionals have been done by [4, 5] by utilizing exploratory and explanatory data mining techniques. The authors have developed various predictive models based on regression viz. Linear Regression, Support Vector Regression, Random Forest Regression, and Lasso Regression.

Machine learning has also been used widely in electric utility load forecasting as well as in reliability forecasting and also to solving complex time series problems. Industries like agriculture, retail, automotive, and wind power generation are also leveraging machine learning [6–10]. Different machine learning methodologies such as neural networks and support vector machines [11, 12] have been deployed in weather forecasting for the past many years. Most research in weather forecasting to date relies heavily on the highly productive approaches, where the weather systems are simulated via these numerical methods or they rely on famous time series models such as ARIMA, Prophet, and Holt winters method. Moving averages have been developed and used in weather and solar irradiance modeling and forecasting [13]. Voyant et al. predicted solar generation from weather forecasts using machine learning [14] and S. Orita et al. predicted Daily Insolation using a multi-stage neural network [15]. The nucleus of this study lies in predicting the temperature solely based on past periodic values. The best-performing algorithm was determined after a comparison of numerous time series analyses and forecasting methodologies.

3   Research Methodology

The flow chart given in Fig. 1 outlines the research methodology. The first step is the collection of temperature time series data which is followed by data pre-processing. All tasks performed under data pre-processing have been elaborated in Sect. 3.1. The pre-processed data is fed to various machine learning models that are regressors. These regression models forecast the temperature after being trained on 80% of input data and tested with a balance of 20%. The machine learning models are evaluated based on performance metrics and finally, the best one is selected. All these steps are discussed in the following sections.

3.1   Data Collection and Data Pre-processing

Hourly forecast data on temperature has been collected from the public repository Australian Government Bureau of Meteorology [16]. The dataset consists of 2300

Fig. 1 Flow chart depicting the research methodology
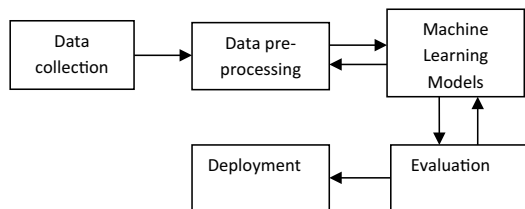
observations of hourly temperature data that are recorded from November 03, 2016, to December 03, 2017. A snapshot of the dataset is shown in Table 1.

Under pre-processing step, the data was checked for any missing values, noise, and outliers. Statistical analysis was performed that helped to get better insights into the given time series about its nature. The mean value was 22.00 and the standard deviation value was 1.40. With the help of this statistical analysis, the Z-score was computed. The Z-score measures how far a data point is from the mean as a signed multiple of the standard deviation. Large absolute values of the Z-score suggest an anomaly in the given data. The above definition can be summarized as follows:

$$X_{\text{scaled}} = \frac{X - \text{mean}}{\text{sd}} \tag{1}$$

The result of the Z-score standardization is that the obtained features are rescaled such that they will have the properties of a standard normal distribution ($\mu = 0$ and $\sigma = 1$). The number of standard deviations with which the value of observation differs from the measured mean value is represented by the Z-Score, also known as the standard score. Values greater than the mean have a positive Z-score while on other hand the values less than the mean score have a negative Z-score. Since it is obtained by subtracting the population mean from each observation and then finally dividing the difference by the standard deviation, hence Z-score is a quantity without dimension. After performing Z-score normalization, it was observed that our dataset did not show any anomaly or outlier. This data could not be input to Holt-Winters' model as it requires only positive values, so min–max normalization was performed on the raw data to scale it in the range 0 to 1 and this transformed data was input to all four machine learning models.

Table 1 A sample of the temperature dataset

Date	Time (in hours)	Temperature (in celsius)
03–11–2016	14:00:13	19.391
03–11–2016	15:00:13	19.158
03–11–2016	16:00:13	19.154
03–11–2016	17:00:12	19.118
03–11–2016	18:00:13	19.058
03–11–2016	19:00:13	19.054
03–11–2016	20:00:12	19.067
03–11–2016	21:00:13	19.075
03–11–2016	22:00:12	19.057
03–11–2016	23:00:13	19.038
04–11–2016	00:00:13	19.002

3.2 Machine Learning Models

After, completing a crucial step of preprocessing, the four most common yet effective forecasting models were selected. These models are the Moving Average, Holt-Winters, ARIMA, and Prophet methods.

Moving Average method

The first technique for predicting the temperature involved using Moving Average. Moving average (also known as rolling average or running average) is one of the widely used time series models which helps to smooth the target variable by filtering out the "noise" which are due to short-term fluctuations. A moving average is a technique that analyses data points by calculating the average of distinct subsets of the entire data set; because it is based on historical values, it is frequently referred to as a trend-following or lagging indicator. In a given time series dataset subset size, that rolls over the data is fixed and the mean is calculated. The first element of the rolling average is calculated by averaging the time series' initial fixed subset. The subset is then adjusted in the next step by "shifting ahead" by one step, removing the first observation of the series, and including the succeeding observation in the subset. Using the Moving average model, the next values in a time series data based on the average of an initial fixed subset of a finite number 'p' is forecasted. Therefore, for all $i > p$

$$T_{MA} = \frac{T_m + T_{m-1} + \dots + T_{m-(n-1)}}{n} \tag{2}$$

$$= \frac{1}{n} \sum_{i=0}^{n-1} T_{m-i} \tag{3}$$

In Eq. (2) $T_m, T_{m-1} \dots T_{m-(n-1)}$ represents the measured temperature of the previous 'n' days and 'T_{MA}' represents the moving average of the temperature.

Holt-Winters' method

This method is based on the exponential smoothening technique which is an essential step for the smoothening of the time series data using the exponential window function. In the case of moving average, the past observation points are equally weighted while in the case of exponential smoothening the larger weights are attached to more recent observations than the observation from the distant past these exponentially decreasing weights are assigned over time with the help of exponential functions—the smallest weight is associated with the oldest observation:

$$\hat{y}_{(T+1|T)} = \alpha y_T + \alpha(1 - \alpha)y_{T-1} + \alpha(1 - \alpha)^2 y_{T-2} + \dots \tag{4}$$

where $0 \leq \alpha \leq 1$ is the smoothening parameter and the rate at which the weights decrease is controlled by the parameter α.

It is also known as triple exponential smoothening and the idea behind this method is to apply exponential smoothening to level, trend, and seasonal components, these components are explained below:

(a) **Level** is that one component that gives us an estimate of the local mean of the data.
(b) **Trend** is the long-term direction of the time series which results from the effects of political or socio-economic factors. The trend can show either growth or decline in a time series.
(c) **Seasonality** is the feature of a time series in which the data experiences regular and predictable changes that repeats themselves in a cyclic pattern.

$$l_x = \alpha(y_x - s_{x-L}) + (1 - \alpha)(l_{x-1} + b_{x-1}) \tag{5}$$

$$b_x = \beta(l_x - l_{x-1}) + (1 - \beta)b_{x-1} \tag{6}$$

$$s_x = \gamma(y_x - l_x) + (1 - \gamma)s_{x-L} \tag{7}$$

$$\hat{y}_{x+m} = l_x + mb_x + s_{x-L+1+(m-1)mod L} \tag{8}$$

Equations (5), (6), and (7) represent the level, trend, and seasonal component respectively, along with the 'α', 'β', and 'γ' being their smoothening parameters. Equation (8) represents the Triple exponential smoothening or Holt-Winters method, where 'm' can be any arbitrary integer meaning we can predict any number point into the future.

ARIMA method

ARIMA is one of the most common yet powerful forecasting methods, it stands for **A**uto-**R**egressive **I**ntegrated **M**oving **A**verage. In an ARIMA model, there are primarily three order parameters: (*p, d, and q*).

(a) An **Auto regressive** *(AR (p))* component is referring to the use of previous values in the regression equation for the time series *Y*. It specifies the number of the lags to be used in the model.

$$Y_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + e_t \tag{9}$$

where Φ_1, Φ_2 are the parameters for the ARIMA model.
(b) 'd' represents the degree of differencing in the **Integrated** (*I(d)*) component. Differencing is often used to make time series data stationary, to make it stationary the difference between two consecutive observations of the data is computed.

$$y_t^{'} = y_t - y_{t-1} \tag{10}$$

(c) The **Moving Average** *(MA (q))* component signifies the error of the model as a combination of the previous error terms e_t. The value of q determines the number of terms that are supposed to be included in the model

$$Y_t = c + \theta_1 e_{t-1} + \theta_2 e_{t-2} + \cdots + \theta_q e_{t-q} + e_t \tag{11}$$

All the above three components combine up to make the ARIMA model which can be represented as a linear equation:

$$Y_t = c + \Phi_1 y_{d(t-1)} + \Phi_p y_{d(t-p)} + \cdots + \theta_1 e_{t-1} + \theta_q e(t-q) + e_t \tag{12}$$

where 'y_d' is the Y which is differenced 'd' times.

FbProphet method

FbProphet is an open-source forecasting tool that is available in both languages viz. python and *R*. It provides easy parameter tuning which helps to generate a meaningful prediction for a variety of problems faced in business scenarios. The prophet at its core is an additive regression model which depends upon historical data and uses time as a regressor. Prophet is laid upon three main pillars:

(a) **Linear or logistic growth trend**: the trend of the time series is often calculated by fitting a piece-wise linear/logistic function over the data and fitting these functions ensures the time series is not affected by the missing data.

$$g(t) = \frac{C}{1 + \exp(-k(t-m))} \tag{13}$$

$$g(t) = \left(k + a(t)^{\mathrm{T}}\delta\right)t + \left(m + a(t)^{\mathrm{T}}\gamma\right) \tag{14}$$

Equations (13), and (14) represent the piecewise logistic and linear function respectively which helps to calculate the trend of a time series.

(b) **Seasonality:** Fourier series are used to fit and predict the effects of seasonality. The equation gives us the intuition of the seasonality component of the prophet.

$$s(t) = \sum_{n=1}^{N} \left(a_n \cos\left(\frac{2\pi nt}{P}\right) + b_n \sin\left(\frac{2\pi nt}{P}\right) \right) \tag{15}$$

'P' represents the period and a_n and b_n are the constants to compute seasonality.

(c) **Holidays:** Holidays play an important role in time series forecasting, especially in stock/sales prediction. Since we are predicting temperature and holidays will play no role in the process of predicting temperature, so we will not use this feature.

$$h(t) = Z(t)\kappa, \tag{16}$$

where,

$$Z(t) = [\mathbf{1}(t \in D_1), \ldots\ldots, \mathbf{1}(t \in D_L)] \tag{17}$$

D_i is the set of past and present dates of the 'ith' holiday, t is the indicator function of the 'ith' holiday and κ is the smoothening parameter (Eq. 16).

4   Results and Discussions

We trained our models on Google Colaboratory which allows us to use NVIDIA Tesla K80 GPU with 12 GB of RAM for up to 12 h straight in a row. We split our dataset in an 80–20 ratio and trained them turn by turn using different methods listed in Sect. 3. The plots with raw data as input have been generated and shown in Fig. 2. The x-axis corresponds to the index of the data and the y-axis represents the forecasted value of temperature. For a better understanding, the graphs have been color coded where 'blue' color represents the actual data,' orange' color represents the predicted values of the Moving average model, 'green' color represents the predicted values of the ARIMA while 'red' color represents the predicted values of the Prophet and finally 'purple' color represents the predicted values of the Holt winters' method. The moving average simply predicted the mean value of the previously fixed 'n' observation. Hence, we could see a straight line plotted. ARIMA model did capture the trend of the time series but couldn't predict according to the expectations. Holt winters' and ARIMA performed quite similarly to each other.

Next, the pre-processing of the raw data was performed using min–max normalization to transform the data on a scale of 0 to 1. The scaled data has been fed to all four algorithms and the results are visualized as shown in Fig. 3. The y-axis shows the scaled values of temperature in the range 0 to 1, and the x-axis shows the index of

Fig. 2 Actual and predicted observation of all the chosen algorithms (unnormalized form)
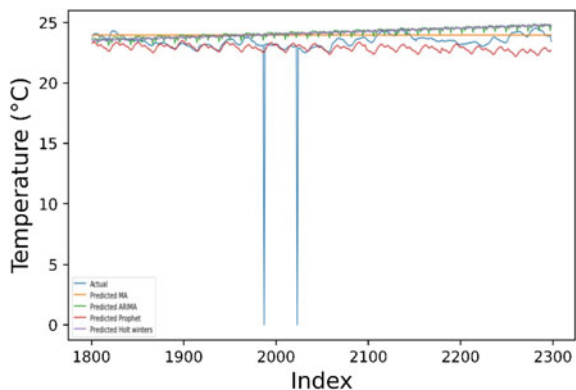
Fig. 3 Actual and predicted observation of all the chosen algorithms (normalized form)
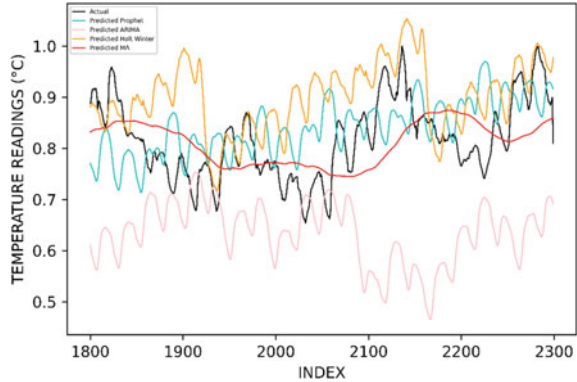
different values. As we can infer from Fig. 3, ARIMA performed poorly, barely even catching the trend of the time series. Holt winters captured the trend, but could not keep up with the sudden changes in the time series. Prophet being the best performer, captured the trend relatively better and also was able to capture the seasonality present in the graph. Moving Average, although the simplest of all captured the trend of the time series and surprisingly performed better than the complex arima models.

The models' performances were measured based on the Root Mean Squared Error, which can be represented by the following equation:

$$\text{RMSE} = \sqrt{\frac{1}{n} \sum_{t=1}^{n} (f_t - y_t)^2} \tag{18}$$

where f_t is the forecasted and y_t is the actual value at time 't'.

The RMSE values were computed where it was observed that Prophet was the best performer by achieving the least value of RMSE values in both the cases but surprisingly Moving Average performed better than Holt-winter and ARIMA achieving a lower error value. This is a classic case that tells us that it is not how complex an algorithm you choose it is how well one understands the problem and acts accordingly.

Table 2 summarizes the performance of all predictive analysis techniques applied to the time series dataset for both the cases and the best performing model could be identified among the four.

Table 2 Computed values for the RMSE metric

	Moving average	Holt-winters	ARIMA	Prophet
RMSE (normalized)	0.17	0.11	0.29	0.087
RMSE (un-normalized)	1.68	1.79	1.75	1.65

5 Conclusion

In this paper, various time series forecasting techniques to predict the hourly temperature have been investigated. The nucleus of the study lies in forecasting the hourly temperature using regression algorithms based on just one variable which is time. In the past various studies have demonstrated temperature forecasting that utilizes numerical models running on supercomputers for weather predictions and requires huge computing power and lots of observational data from land, and air. In this paper, the temperature dataset was pre-processed to normalize the time series using Z-Score to locate anomalies, if any. Next, the raw data were scaled between 0 and 1 using min–max normalization and fed to four different methods of time series forecasting. The performance based on root mean squared error was evaluated and most surprisingly a method as simple as Moving average performed better than the Holt-winters (Triple smoothening) model in case of unnormalized data and it performed considerably better than the ARIMA in both the cases (normalized and unnormalized datasets). Prophet performed the best among the four chosen methods. With the help of this study, deep insight into these forecasting methods and their capabilities were investigated which offers great potential to assist researchers to implement these methods for more bigger and complex problems in the future. These machine learning techniques can complement the traditional approach of temperature forecasting that employs Numerical Weather Prediction models by meteorologists worldwide.

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HCS: A Hybrid Data Security Enhancing Model Based on Cryptography Algorithms

Ankit Singhal, **Jatin Madan**, and **Suman Madan**

Abstract With the advancement in technology, plenty of data is being shared between users using various mediums. And with this excessive data transmission, it needs to be supervised that the data transmitted needs to be secured to maintain the confidentiality and integrity of the data. There is a technique that allows secure data transmission without losing its integrity and classification, and that is Cryptography. In general, Cryptography is about correct encryption, which gives the safe transmission of information and can be interpreted only by a specific source and recipient. For data security, the encryption techniques should meet a set of necessary criteria. This paper proposes a new hybrid cryptographic model and its data security comparison on various parameters with existing Cryptography Algorithms AES and DES. The results indicate better performance as compared to existing algorithms.

Keywords Cryptography · Data security · Encryption · Symmetric key encryption · Private key cryptosystem · Ciphertext · HCS · AES · DES · Security algorithm

1 Introduction

In the present era, Internet has covered the complete globe. It has become a necessity of the people. A substantial amount of data is being kept as electronic messages on websites and social media platforms. And a variety of electronic means, including online chat services, internet commerce, and mobile phone communication, are frequently utilised for data transmission. Unfortunately, those ways of transmitting the data are not very safe. Now it is very common that the data shared over the internet can be easily stolen or monitored [1, 2].

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For secure data transmission, four main data security pillars were introduced to make people believe that they share over the Internet is secure. Those security objectives are Confidentiality, Authenticity, Integrity, and Non-Repudiation. Along with security another important issue associated is privacy [3, 4]. Cryptography is the technique that is used to achieve confidentiality of data, which means that the data shared will remain between the sender and the receiver, no third person will be able to access that data [5, 6]. In Greek cryptography means "Secret Writing". To maintain secrecy, the data is shared in encrypted format using various cryptography algorithms.

In the present scenario, every single bit of data over the internet is in encrypted form. Although most individuals aren't even aware they are using it, cryptography is routinely used by billions of people and organisations to secure their data. Aside from being exceptionally effective, cryptography is also perceived as quite unstable because cryptographic systems can become a significant issue if even a single error occurs rather it is any programming or specification related error [7, 8].

Cryptography completely revolves around the two concepts: Encryption and Decryption. In which Encryption is a process in which the data whether it's text or graphics is converted into an unintelligible form called cipher data. And Decryption is the technique that is used to convert the cipher data back to original data. And the two main types of encryption that are used to encrypt data are Symmetric and Asymmetric Encryption [9].

As depicted in Fig. 1, there are two distinct categories of cryptographic algorithms: Symmetric key and Asymmetric key cryptography. The first type is Symmetric-key algorithm, as shown in Fig. 2, also known as the private key or one key encryption algorithm [10]. As like the Data Encryption Standard (DES) and Advanced Encryption Standard (AES) algorithms, this algorithm uses the same key to encrypt and decode data. There are two different DES techniques: Classical and Modern techniques, in which classical technique is used in Transposition and Substitution Cipher and the modern technique is used in stream cipher and block cipher. The substitution and transposition methods are utilized for transforming the plaintext into ciphertext, where the substitution method substitutes the characters, whereas the transposition approach scrambles the characters to construct a ciphertext. The second type is the Asymmetric key, as shown in Fig. 3, also referred to as a public key cryptographic algorithms, which is similar to the RSA and ElGamal algorithms, utilises onekey for data encryption and decryption [11].

1.1 Concepts Used in Cryptography

- **Plain Text**: This refers to the primary text that the sender intends to convey. As an instance, let's say Ken wants to say "Hello, what are you doing?" to Daniel. "Hi, what are you doing?" is used as simple text in this conversation.

Fig. 1 Types of cryptography
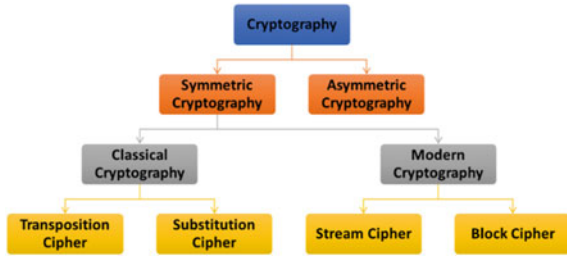
Fig. 2 Symmetric key cryptography
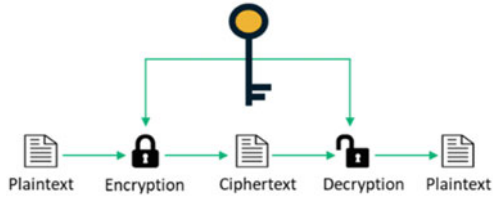
Fig. 3 Asymmetric key cryptography
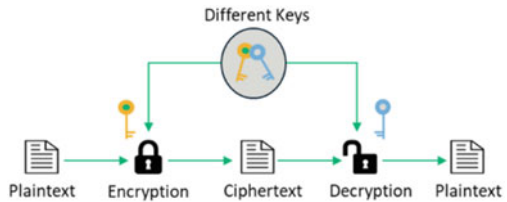
- **Cipher Text**: A message that is difficult for anyone to understand is referred to as ciphertext. For instance, the ciphertext "Pss8$jk48nsn32% > *439jd" was created for the plaintext "Hi, what are you doing?"
- **Encryption**: The method of transforming plain text into ciphertext is known as encryption. An encryption algorithm and a key are the two fundamental things required for encryption.
- **Decryption**: This procedure involves transforming ciphertext into plain text. Additionally, a decryption algorithm and key are required to complete the process.
- **Key**: It is a combination of alphanumeric text or numeric or special symbols. It is one of the major part of the cryptographic system as it is used at the time of encryption or decryption [12].

In this paper, a novel symmetric cryptographic algorithm is proposed, namely Hybrid Cryptographic Standard (HCS) which is designed by integrating the Substitution Cipher and Stream Cipher algorithms.

2 Literature Review

There is lot of work done on cryptographic algorithms for securing data varying from symmetric algorithm to asymmetric algorithms or hybrid algorithms.

Kumar Sharma et al. [10] provided an overview of Cryptography, Modern Cryptography and History of Cryptography. Also, the author discussed about the comparative study of various encryption algorithms like AES, DES, 3DES, RSA, IDEA, ECC, Blowfish and Homomorphic, etc.

Karl et al. [13] presented a theory regarding the relevance of various fault analyses and gave a summary of cutting-edge faulty attacks and their use. Additionally, the author divided the fault analysis techniques into those that applied to block, stream, or sponge-based cyphers.

Gupta et al. [14] gave a brief overview of secure online transactions in the first half of the paper. In the second section, the author introduced basic concepts related to cryptography. In the third section, the author discussed the legal associated risks with secure online transactions. The final section provided a summary of cryptographically secure online transactions.

Vatshayan et al. [15] established a novel hybrid security cypher by combining the essential cryptosystems, Vigenere and Polybius. Compared to traditional cryptosystems, this hybrid encryption algorithm offers extensive security.

Bhargava et al. [16] proposed a novel method of encryption that involves three steps of substitution, transposition, and substitution again. Using this technique, the plain text can be transformed into the ciphertext, which is a collection of different symbols expressed in a certain table, making the plain text challenging to comprehend.

Madan et al. [17] highlighted the issues with the algorithms used to maintain data privacy and confidentiality when the data is huge and also the algorithms' shortcomings were covered in the paper. On the behalf of the comparative analysis, new data privacy preservation was introduced in the paper.

Komalavalli et al. [18] provided an outline of blockchain technology which is entirely based on cryptography. Also, various encryption techniques for securing the blocks and maintain data privacy were also discussed in the paper.

Authors [19–22] provided a comprehensive view of security and privacy in the context of big data, IoT and image steganography and also provided a view of the current status of data security at present along with security and privacy key issues are discussed in depth.

3 Proposed Architecture

In the proposed model the security is maintained by using the 2-level encryption to generate highly secured cipher data out of the provided data. Also, for each level of encryption, the encryption key varies. The first level of encryption is done using the

Fig. 4 Encryption process
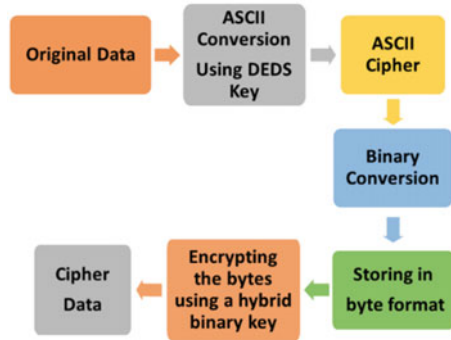
key generated using the Hybrid Cryptographic Standard (HCS) algorithm and after completion of the first level of encryption, the Hybrid Cryptographic Standard (HCS) key is converted to a hybrid binary key to perform the second level of encryption.

3.1 Encryption Process

As shown in Fig. 4 the data has to go through two different levels of encryption and for each level of encryption there are two different types of keys and also for the encryption process the data is converted in different formats for secure conversion.

3.2 Decryption Process

Similar to the encryption process the level of decryption, keys, and type of data varies in the decryption process. In the decryption process, the data has to go through the stream cipher process and the data substitution process to retrieve useful content out of the cipher data as shown in Fig. 5.

3.3 Working

During the encryption and decryption process, the data has to go through two different phases/levels of security. In the first phase of encryption, data, as given in Fig. 6 has to be encrypted using the Hybrid Cryptographic Standard (HCS) key as shown in Fig. 7. Hybrid Cryptographic Standard (HCS) key is the security key that's generated using alphanumeric, numeric, or specials symbols after performing some security checks. After key creation, the data is encrypted using the substitution cipher technique using the generated key, given in Fig. 7. In 1st level encryption, specific bytes of data

Fig. 5 Decryption process
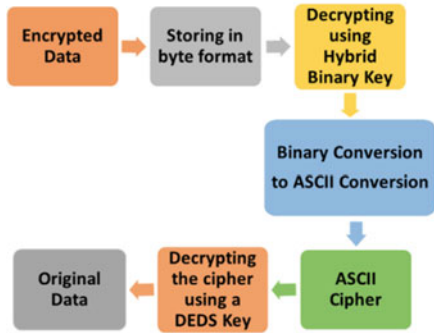
Fig. 6 Original file used for encryption
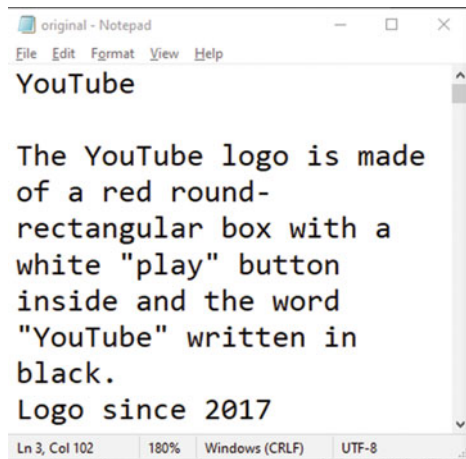
are substituted with some cipher values which are formed using the key. And after substituting the bytes, data is stored in the file in form of ciphertext, shown in Fig. 8.

After the completion of the first phase, the ciphertext, as in Fig. 8 is sent for second-level encryption. For the second level encryption, the Hybrid Cryptographic Standard (HCS) key which is generated in the first phase is converted into binary format and a new secret key is generated using the combinations of the Hybrid Cryptographic Standard (HCS) key and the system-generated key.
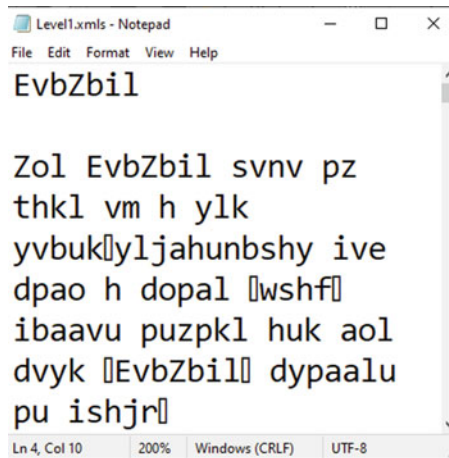
After the key generation process, the ciphertext is converted into bytes and stored into a byte array. In the second level encryption, each byte of data is encrypted using the generated secret key into the stream cipher. And at the end of the encryption process, the encrypted bytes are stored at the user-defined path shown in Fig. 9.

Similarly, In the decryption process, first the user has to enter the Hybrid Cryptographic Standard (HCS) key which is provided during encryption as shown in Fig. 10 and after the key verification the Hybrid Cryptographic Standard (HCS) key is converted into binary format and a secret key is generated using the secret key generation algorithm used in the second level encryption.

Fig. 7 Key verification and encryption process

```
D:\Project testing\File Encryption & Decryption using java\main>java
Crypto
 Enter your choice:
 1. Encrypting Text Document
 2. Decrypting Text Document
 Choice: 1

Enter key:
Enter the path of File to be encrypted (eg: c:\Users\Abc\File.txt) :
original.txt
Enter the path of File to be encrypted data to be saved(eg: c:\Users\
Abc\File.txt) : Level2.txt
2009

- - - - - - - - - Encryption Done - - - - - - - - -
```

Fig. 8 First level encryption result


```
Level1.xmls - Notepad                    —    □    ×
File  Edit  Format  View  Help

EvbZbil


Zol EvbZbil svnv pz
thkl vm h ylk
yvbuk▯yljahunbshy ive
dpao h dopal ▯wshf▯
ibaavu puzpkl huk aol
dvyk ▯EvbZbil▯ dypaalu
pu ishjr▯

Ln 4, Col 10      200%   Windows (CRLF)    UTF-8
```

After the key generation, the stream cipher is converted into byte format and the second level encryption is reversed to get back the data into substitution cipher format. When the substitution cipher file is generated, the cipher file is sent for reversing the first level of encryption which is the ASCII conversion or the substitution conversion. In this, every single byte stored in the substitution cipher is analysed and substituted with the corresponding value provided in the encryption algorithm. At the end of the decryption process, the cipher file is converted back into a plain text file as per Fig. 11.

Fig. 9 Second level encryption result
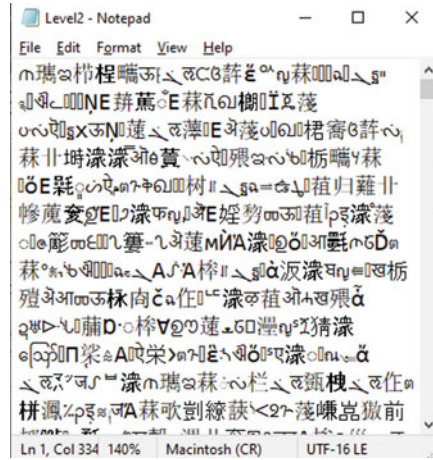
Fig. 10 Plain text/decrypted text
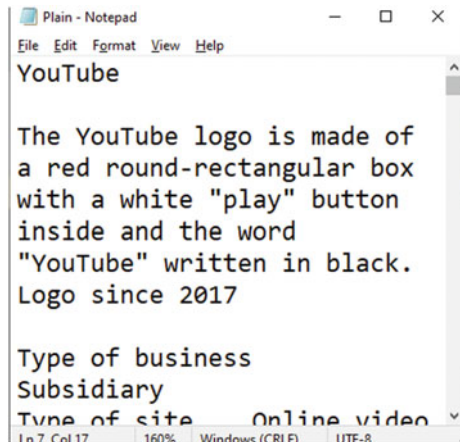
4 Experimentation and Results

For this research, existing AES, DES, and the proposed Hybrid Cryptographic Standard (HCS) algorithm were implemented in the java programming language. After completion of the execution process, all the algorithms were compared based on cipher type, encryption and decryption time, key length, key combinations, levels of encryption, and memory utilization. The algorithm was tested over various datasets with a specific number of characters and also it was tested over text files of a specific size.

For the 1st stage, the algorithm was tested over a text file of size 73 kb containing 72,966 characters including numbers, symbols, space, and alphabets. After this, the algorithm was tested on a file of size 171 kb containing 172,410 characters. For

Fig. 11 Decryption key
verification and decryption
process

```
D:\Project testing\File Encryption & Decryption using java\main>java
Crypto
 Enter your choice:
 1. Encrypting Text Document
 2. Decrypting Text Document
 Choice: 2


Enter key:
Enter the path of File to be Decrypted (eg: c:\Users\Abc\File.txt) :
Level2.txt
Enter the path of File in which Decrypted data to be saved(eg: c:\Use
rs\Abc\File.txt) : Plain.txt


- - - - - - - - - - Decryption Done - - - - - - - - - -
```

the 3rd stage, the file size was increased by 5 times the file used for the 2nd stage, and the number of characters were almost 3.5 times more than the 2nd stage. The file size was 589 kb which contains around 591,877 characters. In last a file with a size of 2356 kb and containing around 2,367,329 characters was used for testing the algorithm. Tables 1 and 2 shows the encryption and decryption results of the proposed model.

During the testing process, it was analysed that the number of characters decreases after the data is encrypted but the size of the file remains the same, and also after

Table 1 Encryption results

S. No.	File size (in kb)	No. of input character	No of output characters (encrypted)	Encryption time (in seconds)	Encrypted file size (in kb)
1	73 kb	72,966	36,919	1.48	73 kb
2	171 kb	172,410	87,642	2.192	171 kb
3	589 kb	591,877	301,538	6.31	589 kb
4	2356 kb	2,367,329	1,205,757	24.02	2356 kb

Table 2 Decryption results

S. No.	File size (in kb)	No of input character (Encrypted)	No. of output character (decrypted)	Decryption time (in seconds)	Decrypted file size (in kb)
1	73 kb	36,919	72,966	1.826	73 kb
2	171 kb	87,642	172,410	2.43	171 kb
3	589 kb	301,538	591,877	7.09	589 kb
4	2356 kb	1,205,757	2,367,329	25.38	2356 kb

decrypting the number of characters gets restored. Other than that, it was also noticed that the decryption process took more time than the encryption process.

5 Comparisons and Evaluations

The proposed HCS model is compared with standard AES and DES algorithms on metrices: Encryption Time and Reliability, as shown in Table 3.

In Table 3, the Encryption Time on a specific set of data is recorded shown in Fig. 12 and also it was tested that how much reliable and secure files are generated after the encryption process. In which the compression level after the encryption process was analysed in terms of total input and output characters, given in Fig. 13.

In Table 4, the Decryption Time on a specific set of data is recorded, and also it was tested that how much secure a file is in terms of decryption as if a file gets decrypted very easily in just a few seconds, then that algorithm is not much secure, given in Fig. 14.

Table 5 provides broad comparison of AES, DES, proposed HCS algorithms based on various factors. After testing and comparing the algorithms on the basis of encryption and decryption time as shown in Table 5, the algorithms were compared on the basis of 10 critical factors which helps to check the security and feasibility of the algorithm. The critical factors were: Average Encryption and Decryption Time, Length of Security Key, Possible Key Combinations, Type of Cipher, Compression Level, Levels/Layers of Encryption and Decryption, Memory Usage, Turnability, and the implementation of the algorithm in different work environments.

Table 3 Comparison of encryption time and reliability

Algorithm	No of input characters	No. of output character (encrypted)	Encryption time (in seconds)
AES	72,966	36,922	1.01
DES		36,915	1.2
HCS		36,919	1.48
AES	172,410	87,575	1.1
DES		87,588	1.6
HCS		87,642	2.192
AES	591,877	301,546	1.327
DES		301,554	2.56
HCS		301,538	6.31
AES	2,367,329	1,206,010	1.655
DES		2,393,288	3.133
HCS		1,205,757	24.02
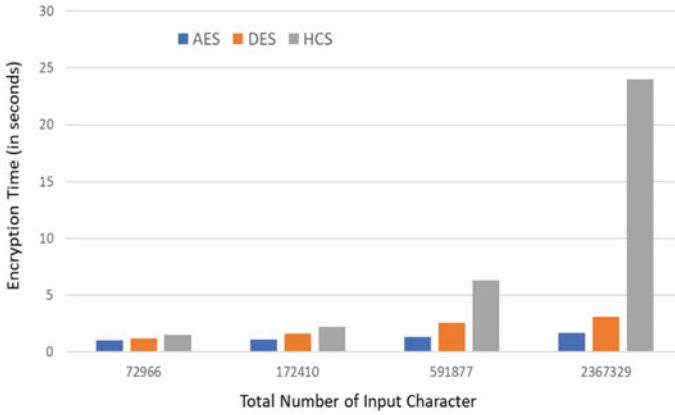
Fig. 12 Comparison of encryption time and reliability
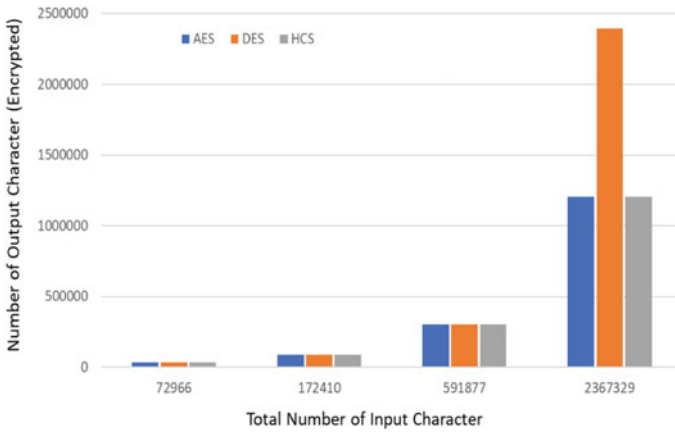
Fig. 13 Comparison of data compression during encryption

6 Conclusion

Encryption play a significant role in data security where encryption/decryption time, Data Optimization, Memory usages, Security Levels, Implementation, and Turnability are the major issues of concern. The selected encryption Advanced Encryption Standard (AES), Data Encryption Standard (DES), and Hybrid Cryptographic Standard (HCS) algorithms are used for performance evaluation.

Based on all the above-mentioned critical comparison factors, it can be concluded that Advanced Encryption Standard uses less memory and Data Encryption Standard takes less encryption time. On the other hand, the proposed Hybrid Cryptographic Standard algorithm might take longer encryption time because when the level of

Table 4 Comparision of Decryption Time

Algorithm	No. of input character (encrypted)	No of output characters (decrypted)	Decryption time (in seconds)
AES	36,922	72,966	1.03
DES	36,915		1.23
HCS	36,919		1.826
AES	87,575	172,410	1.202
DES	87,588		1.71
HCS	87,642		2.43
AES	301,546	591,877	1.4
DES	301,554		2.283
HCS	301,538		7.09
AES	1,206,010	2,367,329	1.803
DES	2,393,288		2.98
HCS	1,205,757		25.38
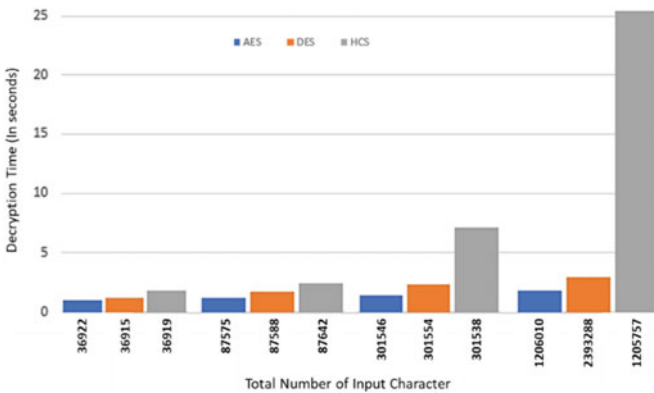
Fig. 14 Comparison of decryption time

encryption is increased the encryption time also increases. But Hybrid Cryptographic Standard algorithm is more useful and secure as compared to Advanced Encryption Standard, and Data Encryption Standard algorithms, as when it comes to security an algorithm is said to be secure when the algorithm gets more intricate and difficult to penetrate, and also the algorithm should be reliable and turnable which means that the encrypted part and the encryption parameters can be dynamically defined for different applications and requirements.

In the future, the proposed algorithm can be implemented in various commonly used devices, and also it can be used in smartphone applications to secure the data. Even in the future, this algorithm can be helpful in speech encryption.

Table 5 Major comparison based on various factors

S. No.	Factors	AES	DES	HCS
1	Average encryption time (in seconds)	1.273	2.123	8.5
2	Average decryption time (in seconds)	1.36	2.050	9.186
3	Key length	256	56	112
4	Maximum key combinations	2^{256}	2^{56}	2^{112}
5	Cipher type	Symmetric block cipher	Symmetric block cipher	Symmetric stream cipher
6	Data compression during encryption	Data compression is there but HCS is more accurate	Data compression is there but HCS is more accurate	Data compression is more accurate than DES
7	Level of encryption and decryption	1	1	2
8	Memory usage	Normal	Normal	Normal
9	Turnability	No	No	Yes
10	Hardware and software implementation	Can be implemented in both hardware and softwares	Better in hardware than in software	Can be implemented in both hardware and softwares

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Use Cases of Smart Contracts in Decentralized Health Infrastructure

Sabita Khatri, Alka Agarwal, Rajeev Kumar, and Raees Ahmad Khan

Abstract The decentralized, peer-to-peer, distributed consensus, and anonymity aspects of blockchain technology have made it a popular research topic over the past decade. The blockchain technology eclipses regulatory issues and technical difficulties. A smart contract is a collection of self-executing, self-verifying, and tamper-resistant computer programs. Smart contracts incorporating blockchain technology are capable of performing a task in real time at a low cost and with a higher level of security. This paper explains the smart contract's various components and operating mechanism. Identify and evaluate the various use cases of smart contracts, as well as the benefits of implementing smart contracts in blockchain applications. The study finishes with a discussion of implementation issues in the future real-world situation for smart contracts.

Keywords Blockchain · Smart contract · Ethereum · Hyperledger

1 Introduction

Demand for blockchain technology has recently increased, resulting in various novel ways to generate and exchange digital assets like Bitcoin and Ether [1]. Because the blockchain is built up of blocks of interconnected nodes, the preceding hash contains the prior node's address. As seen in Fig. 1, the Genesis Block is the first block in the blockchain and has no preceding block hash value. In a chained network, the blockchain provides a shared, immutable ledger with cryptography as the security [2]. It retains an audit record of the agreements made, which various nodes verify. They help to build trust and regulate untrustworthy individuals, making the network

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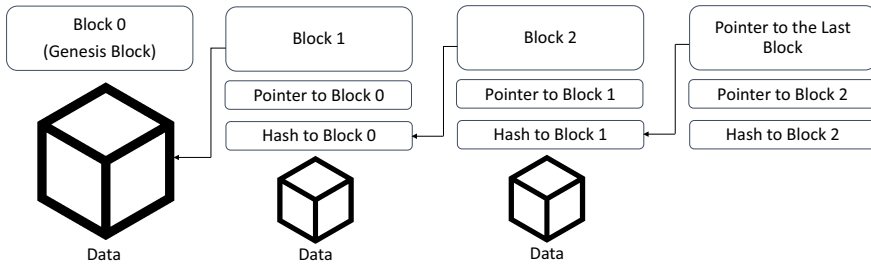
Fig. 1 Basic structure of blockchain

more efficient. These are a few of the unique features that make blockchain appealing to business, finance, medicine, and the Internet of Things. The smart contract is a key component in expanding blockchain functionality. A smart contract is a computer program that executes on the blockchain [3]. It is designed as a digital protocol that runs when certain conditions are met. Smart contracts are computer program that automatically regulate and implement blockchain consensus procedures.

Blockchain systems provide efficient transaction stores, services, and processes, allowing distrustful participants to cooperate without trusted authority [4]. Blockchain technology has grown in popularity over the last decade. A third-party system isn't needed when developers use the blockchain and smart contracts. This allows them to be more flexible and solve real-world problems more quickly and cheaply.

2   Working Concept of Smart Contract

Smart Contracts (SCs) are becoming more popular. In 1994, Nick Szabo defined SCs as "a computerized transaction protocol that executes the terms of a contract." SCs are used in many fields, including finance, law, and healthcare. As a result, a SC is an agreement between parties that is automatically implemented even if they do not trust one another. As a result, SCs are decentralized scripts that are recorded on the blockchain without relying on any trusted authority [5, 6]. The ability to handle more complicated processes and interactions allows blockchain-based systems that support SCs to set up a new paradigm that could be used in almost any way. Decades after the introduction of blockchain technology in 2009, smart contracts have yet to gain attraction among businesses and academics due to the lack of a platform for their execution. The smart contract was added to the blockchain later in 2014, greatly expanding its application potential. Ethereum is a 2014 Bitcoin extension [7]. As a result, Ethereum has become one of the most powerful blockchain adoption motivators. Following the creation of Ethereum, smart contract applications have gained popularity, resulting in a proliferation of new platforms. Corda5, a financial-services distributed ledger platform, was proposed in 2016 to speed up transaction

processing. Privacy is a major issue with smart contracts. Quorum6 has addressed this issue by adding private state tire and other technologies to the Ethereum blockchain [8]. Also, IBM's Hyperledger Fabric7 technology simplifies the use of smart contracts in the real world. It allows firms or consortiums to run it cooperatively to speed up transaction processing while maintaining data consistency and non-malleability. Smart contracts using Hyperledger Fabric have grown in popularity since 2015. Smart contracts in Hyper-Ledger Fabric make sure that data is consistent and can be checked across departments and businesses. Academic researchers are primarily focused on improving open-source public blockchains like Bitcoin and Ethereum. Because people and researchers have been interested in public blockchains, many systems are based on Bitcoin, Ethereum, and other public blockchains, which are used by a lot of people today.

3 Related Work

The benefits of smart contracts in healthcare are becoming more widely recognized as blockchain technology gains acceptance, according to the WHO. Many are unaware of their positive impact on business as a whole. Smart contracts are a powerful application of blockchain technology. Smart contracts and digital agreements are ideal for use in any industry, including health care, due to the security and reliability of blockchain technology. The rising number of patients has put a strain on healthcare professionals' resources. Managing patients' health records and data has become a time-consuming task for many practitioners. Also, the vulnerability of current technologies has resulted in several cases of fraud. Practitioners alone cannot solve these issues. Smart contracts come into play here. Smart contracts are traceable and irreversible. A smart contract stores all transaction data and runs automatically. It is used to create smart contracts on several blockchains, including Ethereum. ErisDB, Zeppelin, and Counterparty, among other companies, are also working on a solidity blockchian platform [3]. Even though blockchain and smart contracts are widely used in many domains, such as IoT access control [9], this paper focuses on various blockchain use cases in the healthcare industry. As a result, this section covers many aspects of current healthcare technology.

A review of blockchain applications in healthcare is provided [10], focusing on their requirements rather than access control requirements. Several authors, including [11], review the extensive literature on blockchain applications in healthcare. However, the healthcare industry has so far ignored blockchain and its programmable smart contracts as a platform for developing decentralized applications that could improve healthcare interoperability [12]. In 2019, a review study on medical data sharing in a blockchain-based system. Reference [13] focused on clinical trials (CT) and created an Ethereum-based smart contract system to manage CT data. The smart contracts on Ethereum are being used to build a telemedicine healthcare system that can't be tampered with and to keep patient data safe, as described in this paper.

This research revealed that most smart contracts have security issues and are only used in the financial sector. Our contributions are: This paper examines the characteristics and workings of smart contracts. Authors have identified seven key use cases for smart contract-enabled blockchain applications. Authors have designed and presented the architecture of seven smart contract-enabled blockchain applications.

4   Potential of Blockchain in Healthcare

Healthcare Compared to other industries, the health care industry is woefully unprepared for information security. When it comes to cross-entity information sharing, corporations' main concerns are security and reliability. Concerns about trust arise from the fact that information can be inputted at any point in the communication chain [14]. Other concerns include numerous suppliers having different copies of the same patient record that have not been verified, resulting in a variety of errors, inconsistencies, and gaps in the patient record's data with reports of data breaches, personal information tampering, and the constant threat of hacking, it's no surprise that health professionals are worried. Health care data management and supply chain management are two excellent examples of major ideas influenced and affected by potential blockchain implementation [15]. Improved data exchange among healthcare professionals can lead to better diagnosis and treatment. A more cost-effective healthcare system will also be improved [16]. Blockchain technology's ability to track data provenance and modifications allows diverse healthcare value-chain players to share network access without compromising data security. The ability of blockchain technology to provide more secure and transparent transaction monitoring is widely used in supply chain management. Using blockchain, transactions can be permanently recorded decentral, reducing human delays, costs, and errors [17]. Access to all electronic health data is enabled by blockchain, allowing for greater efficiency in healthcare delivery [18]. Its transaction layer allows it to quickly access a wide range of anonymous and non-patient-identifying information. Transparency and automation can increase efficiency and reduce administrative costs. It is more appropriate for the healthcare sector since it is a gradual approach rather than an immediate redesign of systems.

5   Smart Contract: Use Cases

Smart contracts can cut expenses by removing payment intermediaries. A smart contract is a code piece, which is installed on a blockchain and automatically executed when specified requirements are met. Smart contracts activate the processing of transactions without requiring a mediator to start this procedure. In this research work, seven potential blockchain and smart contract applications have been identified.

5.1 Interoperability of Health Records

Smart contracts make it possible to store health records on a distributed ledger. With this configuration, patients can simply switch doctors and hospitals without having to transfer their health records or fill out several forms to retrieve their data, which introduces the possibility of errors and jeopardizes record security. Only access permission can be altered in smart contracts. In an ideal world, the patient would be able to go into any clinic, even one in a foreign nation, and provide that clinic access to her medical records simply by entering her private key. This is an example of blockchain interoperability in action, and while it is still a work in progress, many companies are assisting in propelling this topic to the forefront of current innovation [19].

5.2 Health Insurance

Smart contracts have the potential to significantly enhance the existing insurance system by obviating the need for any unneeded intermediaries. When a patient uses smart contracts to purchase a medical insurance policy, the policy information is kept in the patient's blockchain profile and are less susceptible to hacking than when maintained in a traditional database as shown in Fig. 2. Additionally, this will reduce the need for time-consuming insurance claims. When a patient performs an insurance-covered treatment, the smart contract is immediately triggered and funds are sent from the payer to the hospital [20].
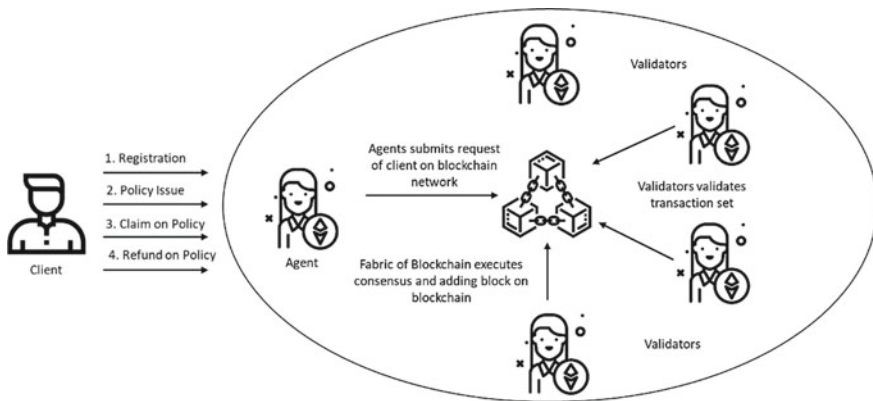
Fig. 2 Health insurance blockchain architecture model
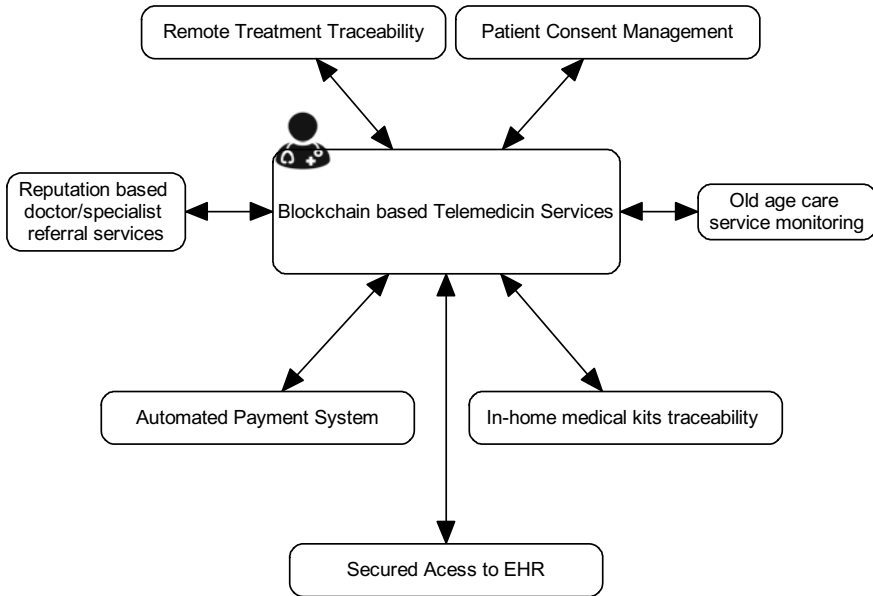
Fig. 3 Telemedicine possibilities for blockchain applications

5.3 Telemedicine

Telemedicine and, more broadly, telehealth technologies are increasing popularity in healthcare. It enables clinicians to communicate with patients through the use of digital devices such as smartphones and the internet of medical things. Physicians can use telemedicine to stream and analyses real-time data from patient's sensors. While this data provides insight into patient's health, it also exposes hackers to new opportunities. Smart contracts may be deployed on a privately owned blockchain to securely gather, analyses, and distribute data [21, 22]. As illustrated in Fig. 3, blockchain solves numerous traditional techniques problems by enabling telemedicine apps to develop trust with patients.

5.4 Drug Tracing

One of the most sophisticated areas is Pharma, and it uses IoT networks in combination with blockchain. This progress is attributed primarily to the problem of counterfeit drugs and the Drug Quality Security Act that tightens the pharmaceutical monitoring and safety management. Counterfeit medicines in the pharmaceutical sector are a significant concern [23]. They create health problems and might possibly lead to death. Furthermore, the pharmaceutical sector has suffered substantial financial

Blockchain for Drug Traceability
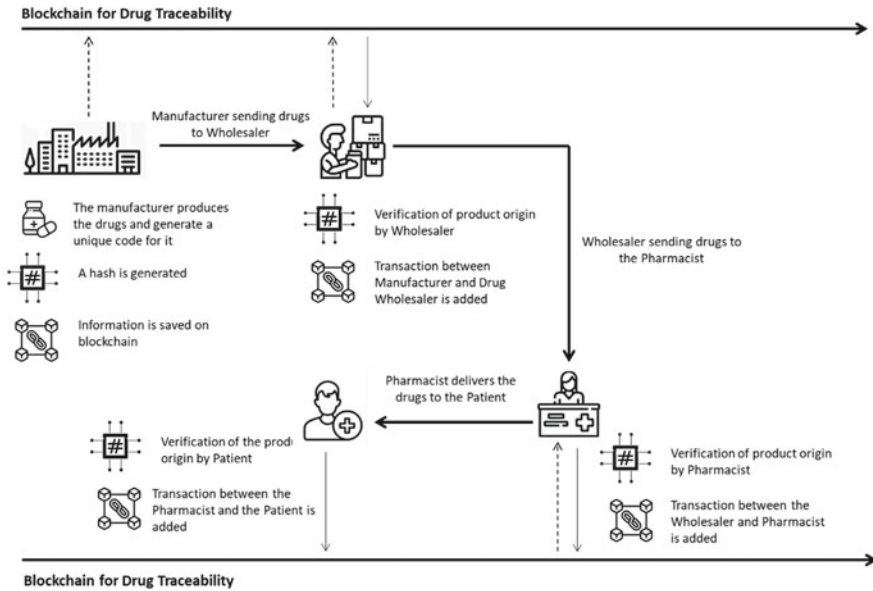
Fig. 4 Blockchain for drug traceability

losses. Between 10 and 30% of all medicines circulating on the market are false according to The Financial Times. Falsified medicines also damage pharmaceutical employment. Blockchain is a solid method to guarantee the validity of drugs since it allows each medication to be tracked to its sources. Blockchain may be utilized at every step of its life cycle to encapsulate medicinal information (such as production, distribution, etc.). Each block of the blockchain containing medication data will be hyphenated and a time stamp will be added to each block that is not modifiable. In such an installation, it is almost hard to circulate a fake medication. Increased blockchain transactions would be accessible to all authorized parties and medicines movement will be trackable in real time as shown in Fig. 4. Medical consumers may also check the legitimacy of items purchased by scanning the QR code and checking for information about the producer and other players in the supply chains [24]. Each member of such blockchains has special rights: producers register their products, pharmacies pick from the suppliers accessible, etc. Any pharmaceutical firm wanting to register its product or buy it with a blockchain must demonstrate to the controlling party its reliability.

5.5 *Increasing the Efficiency of Clinical Trials and Research*

In clinical trials, Blockchain can assist address the fraud problem. Fraud is the modification of facts to hide the true impact of medicines or any other therapy
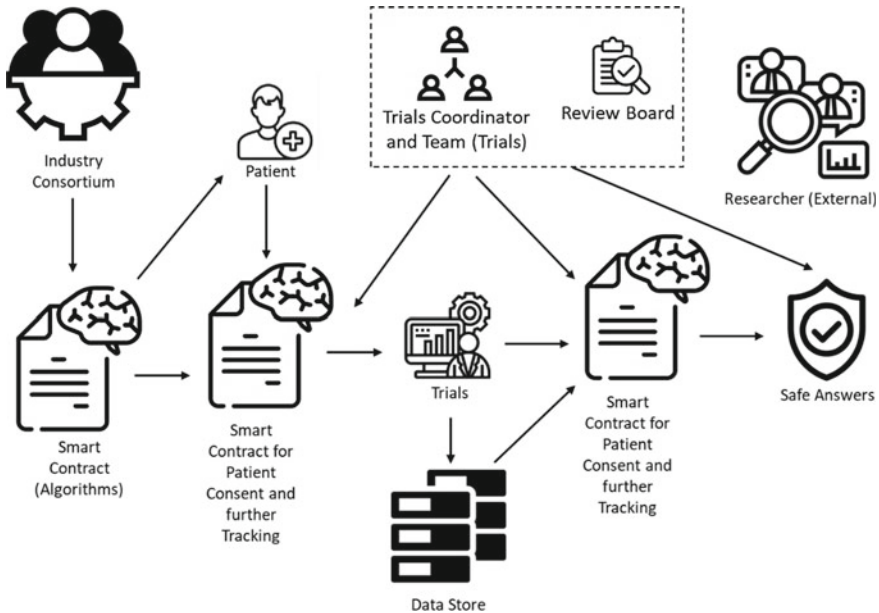
Fig. 5 Blockchain framework for clinical trials and research

being tested. Researchers can rely on blockchain to assure safety and transparency in clinical studies. There you may safely mark and save any papers generated for the purpose of clinical studies. The papers contain ideas for projects, study design, questionnaires, blood testing, and informed parties permission. For clinical studies Blockchain provides many more advantages as shown in Fig. 5. This gives the study carried out legitimacy as each document is verified on the blockchain. The audit expenses are also reduced and the loss of documents or data sets is eliminated [13]. The U.S. Center for Disease Control and Prevention, which considers blockchain for illness monitoring, is an example of blockchain for clinical research. The Center argues that blockchain features such as time stamping and peer to peer reporting will enable disease outbreaks to be reported in real time. The study of illnesses reported will assist scientists uncover disease suppression trends.

5.6 Payments Using Digital Currency

There are also examples of blockchain application of payment-related healthcare. Blockchain, for example, allows medical services to be received and paid for by cryptocurrencies. One instance is Solve. Care, a healthcare blockchain that has collaborated with Uber Health [25] for the transportation of patients. For those willing to give their genomics information for scientific reasons in exchange for a financial benefit,

Blockchain can allow commercialization of health information. Blockchain may then encapsulate its health information and allow bitcoin payments for transactions.

Another notion that is allowed by blockchain is micropayment. Micropayments are innovative, value-based health care models which recompense people for adhering to the directions of their doctors and the lifestyles advised. This model of micropayment, which operates on a blockchain, records every detail of the patient's treatment activities, examines them and retraces them to the patient.

5.7 Patient Data Management and Sharing

By the end of 2018, over 350 data breaches, resulting in 13,020, 821 health records exposure, have been reported to the Department of Health and Human Services. HIPAA has tight rules on patient records privacy. At the same time, such documents cannot be isolated, because a number of parties save the patient and the physician may require access for the well-being of a patient. The handling of patient data using a traditional manner, while distributing these data via multiple databases of healthcare, has been a difficult issue. Blockchain overcomes these problems, while preserving security and access control, by providing a single platform to store and manage all important data at one place [26–28]. Patient data are kept as blockchain blocks which may be identified using the unique ID of the patient. This design also enables information (blocks) about health to be shared without exposing the ID if the patient wants, for example, to remain anonymous during clinical investigation. Blockchain enables patients to have immediate access to medical information from their trusted care providers. This is very helpful in the treatment of elderly or unconscious people as shown in Fig. 6. The UK-based business medical chain, for example, lets users to obtain health information using a smartphone to scan a restricted wristband.

5.8 Blockchain for Electronic Health Record

Blockchain technology is also a dependable option for the administration of population health data [29–31]. With the old approach, information about each patient is dispersed among a number of different systems that are not compatible with one another. As a result, collecting health data for a specific population cluster is a difficult process to do. Participating in population health research and monetizing the results of these studies are made possible by the blockchain, which provides a consistent and safe platform for everyone as shown in Fig. 7.
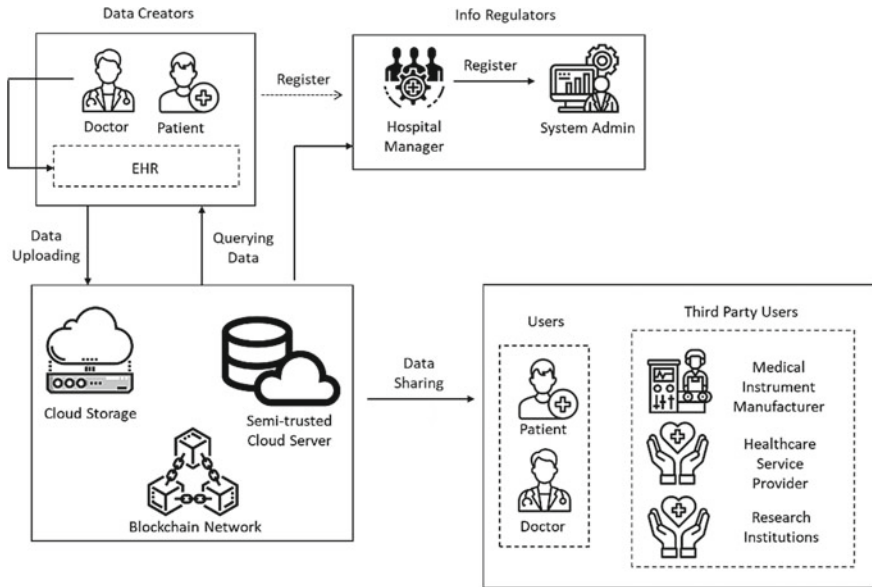
Fig. 6 Data management and sharing architecture model of blockchain
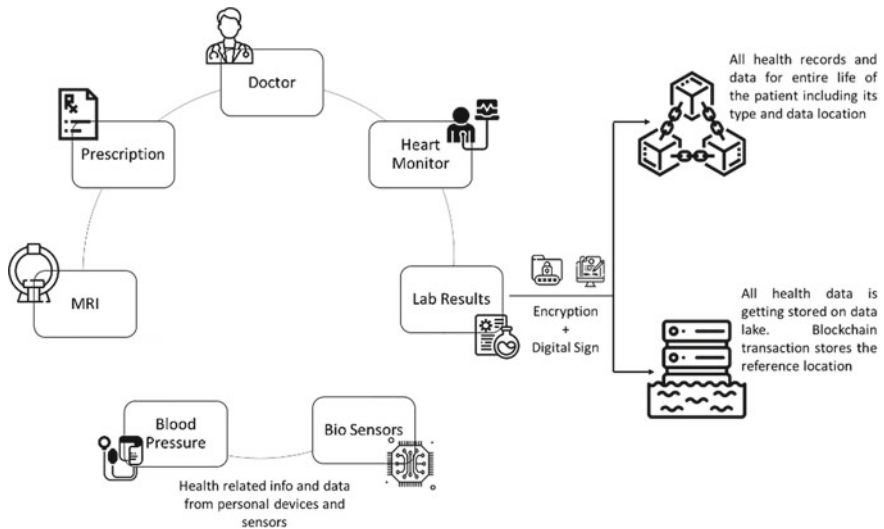
Fig. 7 Electronic health record architecture model of blockchain

6 Conclusion

Healthcare organizations are presently challenged with a number of difficulties, including human error, data security, pharmaceutical supply chain transparency, a lack of interoperability across databases, and a lack of consistency in the distribution of healthcare-related information. The existing state of affairs makes real-time exchange and access to healthcare data more difficult. To overcome these difficulties, the use of blockchain technology and smart contracts is being explored, and it has the potential to significantly enhance and transform the healthcare sector as a whole. Blockchain technology offers a diverse variety of applications and uses in the healthcare industry. The use of ledger technology allows the safe transmission of patient medical information, the management of the pharmaceutical supply chain, and the unlocking of genetic code by healthcare researchers. The use of smart contract solutions can help to considerably streamline and secure healthcare data management while also facilitating drug tracking and automating procedures and deterministically process numerous modules in a specify way and trigger the events that are associated with them. In this paper, the authors have tried to explain the use cases of smart contracts. Each of these application areas is explored in detail, with a thorough discussion of smart contract taxonomy and architecture provided.

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Power Divider Design and Analysis for 5G Applications: A Comparative Study

Vidhi Sharma and Sukhpreet Singh

Abstract Power dividers are the passive electronic equipment used for splitting the power. They are now being employed in a variety of communications applications such as telephonic, antennas configurations, mobile connectivity, internet technology, & optics, etc. They come up with very low loss, operate at high frequencies, and provide significant isolation between output ports. This manuscript aims to discuss a comparative investigation on designing power dividers for 5G applications. T- junction Power Divider, Branch line coupler, and Wilkinson Power divider are designed & simulated in advanced design system (ADS) software at the sub-6 GHz freq. band. The most efficient results were obtained by the Wilkinson Power divider.

Keywords Power divider · ADS · Impedance match · Even–odd mode · WPD

1 Introduction

A power divider (PD) is among the recognized conventional passive components which receive an input (I/p) signal & delivers multiple output (O/p) signals to different O/p ports, with specific phase and amplitude characteristics [1].

Power Dividers often called power splitters, are commonly employed in radio technology. They connect a certain quantity of electromagnetic energy in a transmission system to a terminal, allowing the signals to be utilized in another network (N/w). PDs are utilized in a variety of applications including mobile comm., antennas layout, internet technology, computer N/w, optoelectronic devices, Cable television devices, etc.

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The N/w design must possess the following characteristics: very low loss, operate at high frequencies, and provide significant isolation between O/p ports [2].

The tool used to design the PDs is advanced design system (ADS). It is a technology platform for electrical systems engineering (EDA) that allows engineers of RF electronics devices like smartphones, N/w, PSs & couplers, satellite comm., radar systems, & high-speed data links. Each stage of the design process is supported by ADS, including schematics, layouts, configuration verification, frequency-domain, & time-domain circuitry, & EMF modeling, enabling the designer to thoroughly characterize & optimize an RF design without switching tools [3].

Segment 2 gives a summary of relevant tasks completed in designing PDs. Segment 3 gives the mathematical analysis of WPD. Segment 4 provides the steps to design the layout of PD & their o/p. Segment 5 gives the comparison of PDs that are designed & also with the previous published WPDs. Segment 6 concludes the paper based on designed PDs.

2 Related Work

Khajeh-Khalili and Honarvar [3] proposed a design of triple lines WPD for app. in mobile communication systems [3]. Here, the WPD uses TLs instead of the standard quarter transmitter line making the architecture capable to operate across several frequencies with simple design & high isolation at O/p ends.

Kalpanadevi et al. [4] designed & analyzed the WPD using microstrip line and coupled line techniques [4].

Zhu et al. [5] proposed a planar PD through processing, configurable output split, as well as a configurable spectrum for mobile comm. System [5]. This suggested structure is relatively small.

Elsayed et al. [6] designed a 1:4 active PD for 5th Generation Tx using incremental in 22 nm complementary metal oxide semiconductor FDSOI [6]. Compared to other passive PDs & active PDs, the configuration has a performance improvement of 1–2 dB as well as a small size.

Kenan et al. [7] did a parameterized analysis & modification of a double 4-port WPD that exhibits good characteristics at WLAN freq. in terms of return loss & isolation [7].

3 Theory of Power Dividers

3.1 T Junction PD

A T junction PD shown in Fig. 1 is a conventional 3-terminal n/w & could be utilized for either splitting or coupling. This PD could be made by using waveguides such

Fig. 1 Equal split WPD [1]
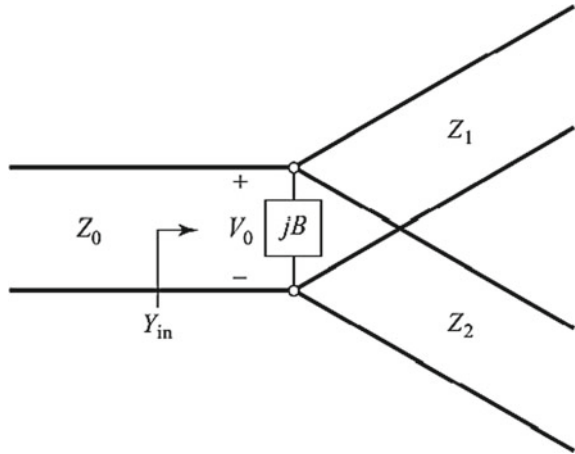
as E-plane, H-plane, or microstrip lines. As the name suggests the shape of this PD will be something like the T alphabet.

3.2 Wilkinson PD

The WPD is a lossy 3 port n/w that has all ports matched & isolated. It splits a signal into two similar O/p signals in phase [8].

Figure 2 shows an image of equal split WPD in which power flowing through port 1 will be equally split into ports 2 & 3. The scattering characteristics for a 2-way equal-split WPD are given by:

$$[S] = \frac{-j}{\sqrt{2}} \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

Examination within the S array demonstrates that perhaps the circuit is symmetrical i.e., Sij = Sji, ports are in sync i.e., S11, S22, S33 = 0, O/p ports are not

Fig. 2 Equal split WPD [9]
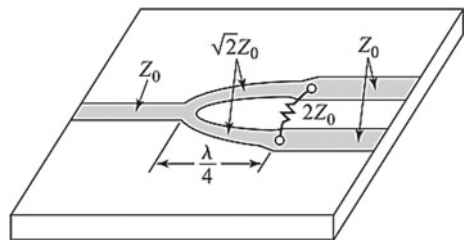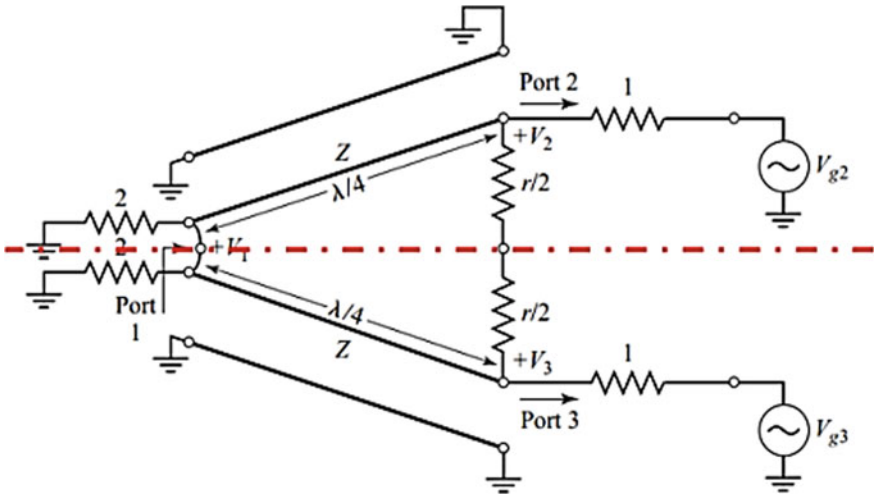
Fig. 3 Standardized & Symmetrical form of WPD [10]

connected i.e., S23, S32 $= 0$ assuming that equivalent power distribution is attained i.e., S21 $=$ S31. A perfect WPD would produce $S_{21} = S_{31} = -3$ dB $= 20\log_{10}(\frac{1}{\sqrt{2}})$. The WPD is reconstructed in a standardized symmetrical form in Fig. 3.

The voltage on the transmission line may be stated using the x-axis is:

$$V(x) = V + \left(e^{-j\beta x} + \Gamma e^{j\beta x}\right)$$

$$Ve^2 = jV + (1 - \Gamma) = Vo$$

This gives, $Ve^1 = V + (1 + \Gamma) = jVo\frac{\Gamma+1}{\Gamma-1}$

Here $\Gamma = \frac{2-\sqrt{2}}{2+\sqrt{2}}$, So, $Ve^1 = -j\sqrt{2}Vo$.

Based on these findings, we may conclude:

$$[S] = \begin{matrix} 0 & -j/\sqrt{2} & -j/\sqrt{2} \\ -j/\sqrt{2} & 0 & 0 \\ -j/\sqrt{2} & 0 & 0 \end{matrix}$$

3.3 Branch Line Coupler

Branch line couplers shown in Fig. 4 are three dB radial combined n/w with a 90° phase diff. b/w the coupled as well as through arms. The coupler often referred to
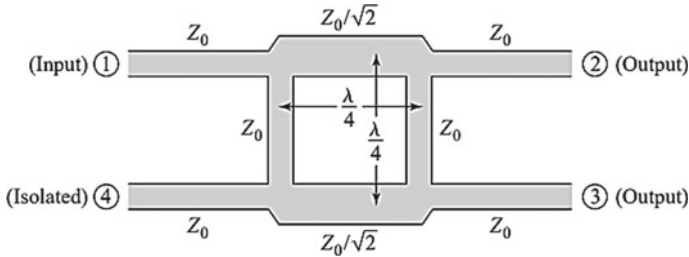
Fig. 4 Hybrid coupler [1]

as a hybrid coupler, is usually formed inside the structure of a dielectric substrate or microstrip.

4 Design Flow/Process

The physical characteristics of microstrip for all the 3 designs remain the same such that: ε_r of the substrate is 4.6, the height of the dielectric is 1.6 mm, loss tangent would be 0.0023, the metal height is considered as 0.035 mm, & the material used as a conductor is a perfect conductor which is intruded into substrate above the interface by thickness 0.035 mm as shown in Fig. 5.

4.1 T Junction Power Divider

- L&W for 50 Ω connection are considered to be 13.4 mm and 2.9 mm respectively. L&W for 70.7 Ω connection are given as 13.8 mm and 1.5 mm respectively.
- Develop a conceptual design of the T junction PD in the ADS software design tool. This is possible with the T Lines-Microstrip library.
- Use the determined width for the 50 Ω connection; the L of the model is less essential. Within this scenario, TL-1 is a quarter-wave transformer, while TL-3 & TL-4 are 5 mm long.
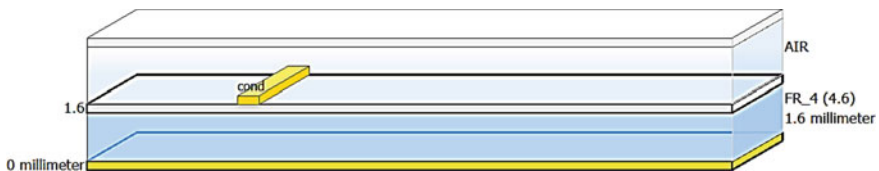
Fig. 5 Dielectric substrate
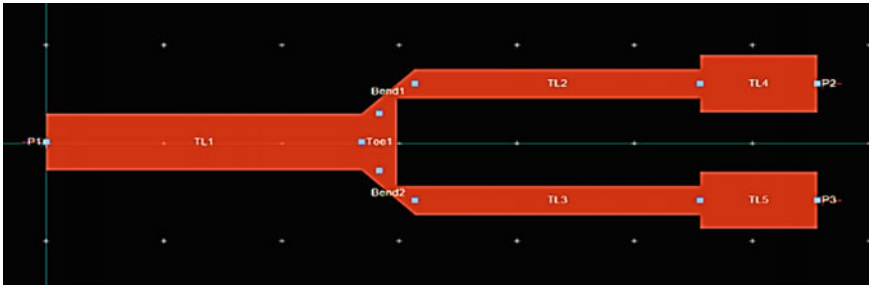
Fig. 6 T junction microstrip layout
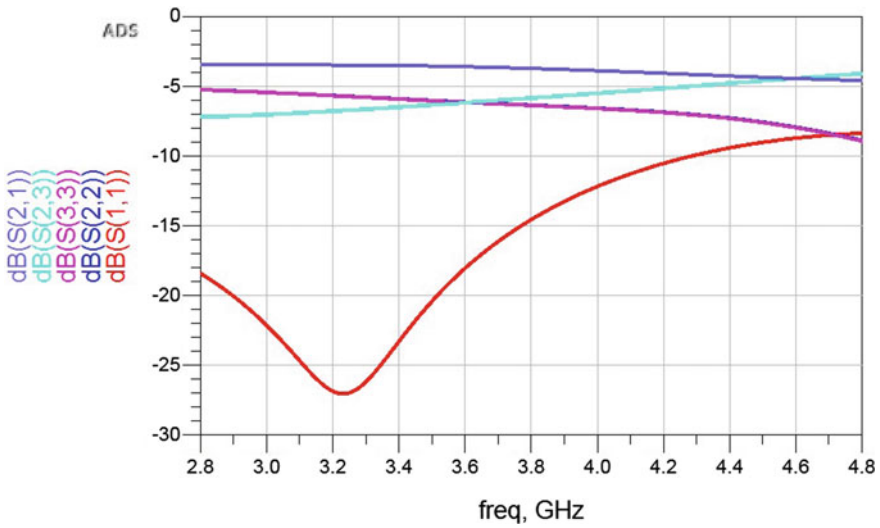
Fig. 7 S parameters for the T junction

- The layout and simulation results of designed T junction PD are shown in Figs. 6 and 7 respectively.

4.2 Wilkinson PD

- L&W for 50 Ω connection are considered to be 1.27 mm and 0.61 mm respectively. L&W for 70.7 Ω connection are given as 0.254 mm and 0.2626 mm respectively.
- The schematic for the designed WPD is given in Fig. 8 and EM model as well as simulation is shown in Figs. 9 and 10 respectively.
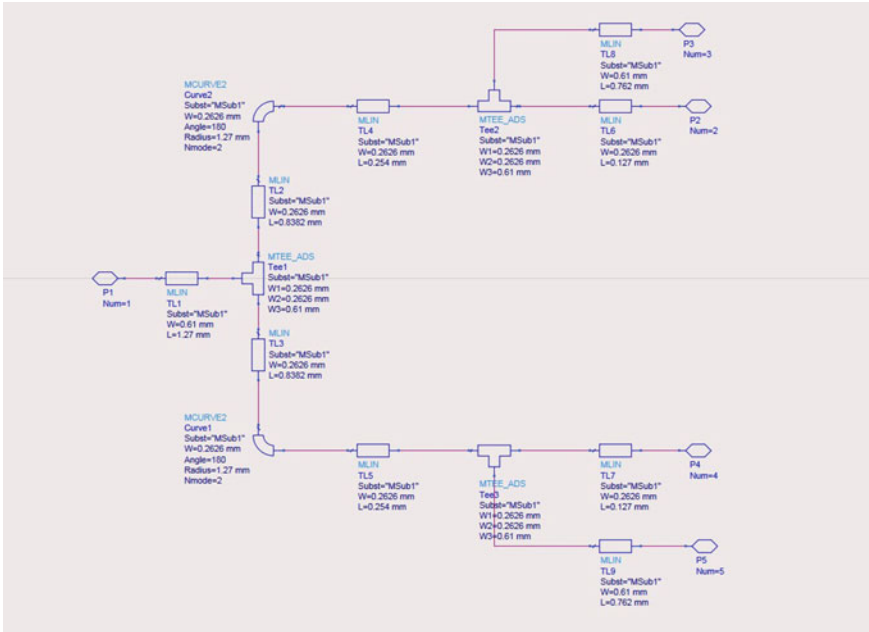
Fig. 8 Schematic of proposed WPD
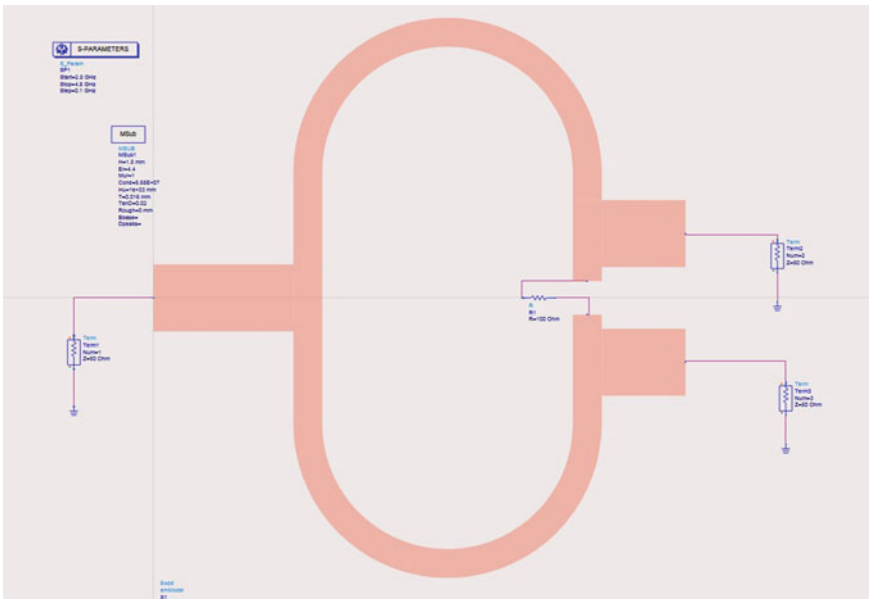
Fig. 9 EM Model for proposed WPD
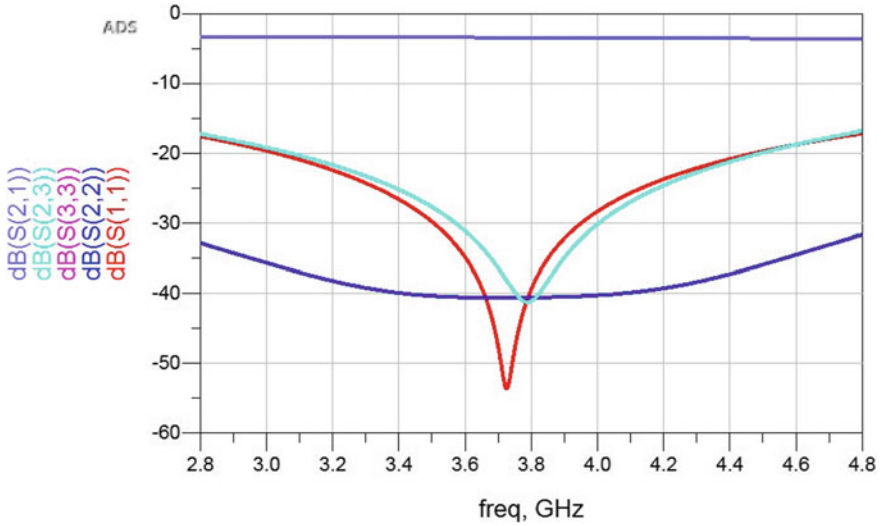
Fig. 10 S parameters for the WPD
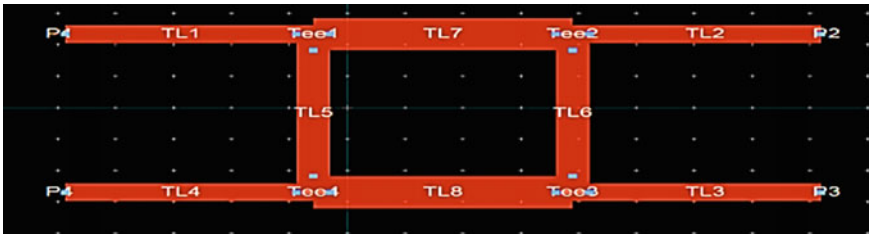
Fig. 11 Branch line coupler layout

4.3 Branch Line Coupler

- L&W for 50 Ω connection are considered to be 20 mm and 2.9 mm respectively. L&W for 35 Ω connection is given as 19.5 mm and 5.14 mm respectively as shown in Fig. 11.
- Once the simulation is complete, display the o/p as shown in Fig. 12.

5 Results Comparison

Table 1 gives the comparison of parameters that are obtained from the results after simulation in ADS software.
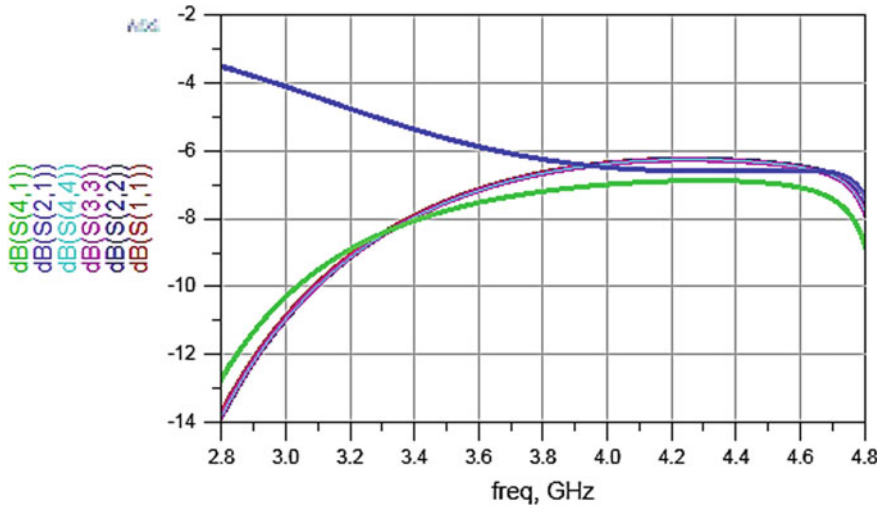
Fig. 12 S- parameters for coupler

Table 1 Parameters comparison

PDs/parameters	T junction	Wilkinson	Coupler
Frequency (GHz)	3.802	3.802	3.802
S (1,1)-Input return loss (dB)	−14.552	−39.153	−6.645
S (2,2)-Output return loss at port 2 (dB)	−6.348	−40.590	−6.666
S (3,3)-Output return loss at port 3 (dB)	−6.360	−40.590	−6.667
S (2,1)-Insertion loss (dB)	−3.715	−3.414	−6.257
S (3,1)-Insertion loss (dB)	−3.708	−3.414	−5.970
S (2,3)-Isolation loss (dB)	−5.835	−41.036	−7.202
S (3,2)-Isolation loss (dB)	−5.835	−41.036	−7.202

It can be seen from the obtained parameters that all the dividers are simulated for sub-6 GHz freq. band. The o/p return loss at ports 2 & 3 is better for WPD design than T junction & coupler. The isolation loss is also high for WPD.

From the comparison in Table 2, it can be observed that the proposed WPD design has good results as compared to the other designs which makes it suitable for operating in cm wave frequency. Also, all the compared designs use a frequency of low to mid-range band.

Table 2 Comparison of Proposed WPD with other Published Studies

Ref./parameters	[5] (2017)	[8] (2019)	[11] (2020)	[12] (2020)	Proposed WPD
Frequency	915 MHz	2.5 GHz	3.5 GHz	2.9 GHz	3.802 GHz
S (1,1) in dB	−8.852	−24.344	−32.397	−25.665	−39.153
S (2,2) and S (3,3) in dB	−8.852	−25.652	−29.689	−25.665	−40.590
S (2,1) and S (3,1) in dB	−3.656	−3.585	−3.242	−3.303	−3.414
S (2,3) and S (3,2) in dB	−14.209	−29.146	−40.162	−29.994	−41.036

6 Conclusion

The comparative analysis of 3 basic types of PDs i.e., T junction PD, Wilkinson PD & Hybrid coupler is presented in this paper. All the layouts are designed in ADS software. The most efficient results are obtained from Wilkinson PD as it provides better isolation b/w o/p ends than a T-junction type PD. The I/p return loss is found to be -39.153 dB, O/p return loss at ports 2 & 3 is -40.590 dB. The insertion loss is -3 dB & isolation loss is -41.036 dB. Separation among terminals is accomplished by the use of terminated resistance. It is the most robust design & offers low insertion loss which makes it the best design for 5G applications.

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An Analytical View of Evolutionary Development of Computing Database Research in Fifty Years

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Abstract The field of computing databases has seen an enormous research growth since they were proposed in the early 1970s. The current research work, for the first time, presents the analysis of the evolutionary development of research in this field for the period from 1976 to 2021. An analysis of the design of research paper titles as well as the top scientists of the field have been presented. The trends in the number of authors and unique authors for a given paper have also been presented for more than 1700 authors of more than 1000 research papers for this period spanning 46 years. It has been found that less than 1% of scientists have authored more than one-tenth of the papers while more than 20% research papers have been sole authored. For 75% cases a unique author was present in the author list of the research paper while more than 90% of the papers have been authored by up to 4 authors. The average title length has been found to be nearly 1300 characters. Based on the analysis of data of almost half a century, a clear linear trend of increase in the paper title length as well as the number of authors has been observed. The presented results have huge implications and applications in stylometric, scientometric as well as bibliometric studies. The results are also important for the agencies providing research sponsorships and grants.

Keywords Author · Computing · Databases · Research paper · Research trend · Title

1 Introduction

In the scientific community, mostly the developments in any field are gauged by the research publications in that field. This in turn involves the role of a number of stakeholders like the authors, reviewers, editors, publishers and citers of the research papers. For any research paper under question, there could be a number of factors like the length of the research paper, length of its title, number of references, and the

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recency of references which could have an impact on the influence that the research paper exerts in the field. The use of specific characters in the title (e.g. '?') to design interrogative title statements [1, 2] and the humor conveyed by the title [3] also play a role in the possible citations of that research paper.

For the first time in the scientific community, the present research work explores, analyzes and presents the results for the field of computing databases. We have specifically used the term 'computing databases' to keep the term generalized and have it differentiated from any specific database which could deal with spatial data, multimedia data, textual data, bioinformatics data, corporate data, statistical data, etc., which are all subtypes of the more generic term per se. Oracle states that "a database is an organized collection of structured information, or data, typically stored electronically in a computer system" [4].

The remaining part of the paper is organized as follows. Section 2 presents the review of relevant related literature. Section 3 presents the methodology followed for the research work while Sect. 4 presents the results, findings and discussion thereon. The last section of the paper presents concluding remarks, limitations of the present research work as well as draws the line for future work.

2   Literature Review

The title of the research paper has always played a critical role in the research world. The characteristics of the title of the research paper have also been an area of extensive debate among the research community. Saini and Desai [2] analyzed 65 stylometric features to compare the titles of research manuscripts of Indian authors and those authored by foreign scientists. They proved that the question mark ('?') and asterisk ('*') are consistently the most used characters in the design of research paper titles by both the Indian as well as foreign authors. Heard et al. [3] discussed the possibilities of better citations of research papers with funny titles. In general, it is not just the title of the research papers but title of any document has been researched by the authors. For instance, Taher et al. [5] analyzed the titles of news for the detection of fake news. However, we have restricted the scope of our literature review to titles of research papers only. Based on the analysis of more than 17,000 research papers, it was proved by the researcher in [6] that almost 90% research papers have up to 3 authors.

Bramoulle and Ductor [7] advocated that the shorter titles are published in the journals of better quality. Milojevic [1] analyzed various characteristics of the paper titles and proposed that it is not necessary that the titles framed as interrogative statements attract more citations. A linear regression model was applied by Habibzadeh and Yadollahie [8] to analyze the relationship between the length of the title of the research paper and the number of the citations received by the research paper. Letchford et al. [9] attempted to analyze the significance of the research manuscript based on the length of the title of the manuscript and concluded that shorter titles are better.

Based on the increasing number of authors in the research articles, Bi [10] suggested to consider the fractional h-index for the authors. Based on the sample size of 60 research articles, Ghahramani et al. [11] suggested that the researchers should collaborate with others for improving the quality of the research articles. Maltseva and Batagelj [12] observed that the number of single authored papers is decreasing significantly. They used the data since the 80s for deriving the conclusions. From the perspective of analysis on social media, they also lamented the existence of multiple identifications of the same set of authors. Johnson et al. [13] attempted to analyze the particular role and participation of the female authors in the conferences. They restricted the scope of their research to the field of neurological surgery only.

For a period of five years, Plummer et al. [14] attempted to analyze the correlation between the number of the authors of a research manuscript and the number of organizations with which these authors were affiliated. They clearly found that there is a clear trend towards an increase in the number of authors. Shaffer [15] presented that there are only less than 5% research papers in the medical domain which are single authored. Boyer et al. [16] advocated for a unique method of counting the author contribution in a paper which is based on the percentage of the scientific work done by the author for a research paper. Castelvecchi [17] discussed the trend in the increasing number of authors for the research papers and highlighted the case of a research paper with 5154 authors where the actual research article contained just 9 pages of the total length of 33 pages of the article.

Hence, a number of research works has been done on the analysis of research paper titles and the number of authors, but they have focused only towards the fields like social network [12], neurosurgery [13], pharmacy [14], medicine [15], and physics [17]. To the best of our literature review, there is no research work that specifically and formally analyzes the particular trends in the field of computing databases though the field has seen an enormous research growth for a period of almost half a century. The present research work proposes to bridge this gap. As is clearly evident from the related literature review and given the number of researchers working in these areas as well as the interest of the research community in the possible applications of these areas, it is believed that this paper will have an excellent impact on the similar and contemporary research works.

3 Methodology

The analysis of research titles for the field of computing databases demanded a corpus big enough to accommodate all the developmental research publications of the field. At the same time, the corpus was required to assure the quality of research manuscripts published during this entire period. An important expectation from the corpus was the consideration and inclusion of the sentinel research papers of the field. In order to fulfill all these criteria and assure that only papers of highest quality are included, we collected all the research papers published in the field of computing databases only from the ACM Transactions on Database Systems (ACM TODS)

available publicly at https://dl.acm.org/journal/tods and for a period from the year 1976 to 2021.

In the next step, the titles of research papers were extracted from all the published documents in the said period. This provided us with a list of research titles. It is notable here that in order to maintain the sanctity of the corpus, we considered only the actual research articles published. Therefore, we excluded all the publications of the type corrigendum, addendum, charter, foreword and editorial. The final list contained 1031 titles of the actual research papers.

We also extracted the author list from each of 1031 papers published during the period of almost half a century. This was done manually and individually for each research paper. The total number of authors thus obtained was 2788, out of which 1765 were unique authors. It is noteworthy to mention that the present research work uses the terms 'scientists', 'researchers' and 'authors' interchangeably and synonymously, unless explicitly stated. Further, the focus for the author list of each paper was on the number of authors and therefore we did not consider the relevance of the order of the authors. For instance, we treated all the authors at par irrespective of whether any one or more of them were corresponding author(s). Similarly, no specific consideration was given to the first author in the list of the authors. This was done as we observed that the papers can have multiple corresponding authors. Further, it was beyond the scope of this research work to decide whether the quantum of work contributed by the corresponding author, first author or any other author in the list was more or less than the other. Additionally, unlike Johnson et al. [13], we did not consider the differentiation of the authors based on the gender of the scientists in the author list.

The resultant lists of titles of research papers, authors of research papers and unique authors of research papers, were all subjected to statistical analysis including the correlation between the number of authors and the title length. The results of these experimentations and statistical analysis are presented in the next section.

4   Results, Findings and Discussion

After the exhaustive analysis of the data of more than four decades, we were able to find some comprehensive results which are presented in this section. Table 1 presents the data on the number of authors compared with the number of papers. The first two rows of the Table 1, for instance, respectively indicate that there were 209 papers which were authored by only and exactly 1 author while there were 324 papers where the number of papers were exactly 2. In Table 1, the third column and the fourth column respectively present the percentage share of the total number of papers, and the cumulative percentage share of the total number of papers, both with respect to the number of authors. The values depicted in the Table 1 are rounded up to two decimal places. It is notable that more than 51.70% of the total number of papers is either authored by 1 or 2 authors while 90.30% papers are authored by 1 or up to 4 authors.

Table 1 Statistics on number of authors and papers

No. of authors	No. of papers	% share of total (A)	Cumulative A
1	209	20.27	20.27
2	324	31.43	51.70
3	248	24.05	75.75
4	150	14.55	90.30
5	60	5.82	96.12
6	20	1.94	98.06
7	7	0.68	98.74
8	7	0.68	99.42
9	3	0.29	99.71
10	1	0.10	99.81
11	1	0.10	99.90
12	0	0.00	99.90
13	0	0.00	99.90
14	1	0.10	100.00
Total	1031	100.00	–

Further, the maximum number of authors was found to be 14 and there was only one such paper. Including and beyond the author count of 4, it could be interestingly noted that the number of papers has consistently reduced by almost half with each increment of 1 in the number of authors. The data presented in Table 1 is presented graphically in Fig. 1. Figure 1 indicates that as the number of authors increases there is a decrease in the corresponding number of papers authored by them.

Table 2 presents the frequency of unique authors against the paper count. For instance, the first row of Table 2 indicates that it was 1314 times that a distinct person authored 1 paper. In other words, we can say that there were 1314 instances of unique authors who had authored a single research paper. If this data is compared with data presented in Table 1, then it could be easily noted that out of 1314 instances, 209 instances involved only the case of a sole author. Similarly, the second row of
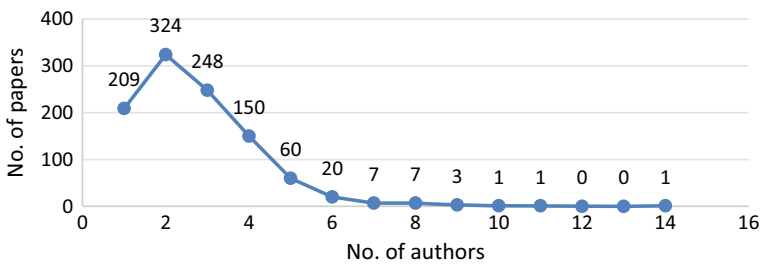
Fig. 1 Representation of no. of papers against the no. of authors

Table 2 Frequency of unique authors for different paper counts

Paper count	Frequency of unique authors
1	1314
2	232
3	102
4	36
5	26
6	25
7	11
8	6
9	5
10	1
11	0
12	1
13	3
14	0
15	0
16	2
17	1
Total	1765

Table 2 indicates that there were 232 unique authors each of which had 2 papers. The last row of Table 2 presents the total number of unique authors, which was 1765.

The data presented in Table 2 is depicted graphically through Fig. 2. The Y-axis of Fig. 2 is marked with a '~' (tilde) to indicate (a) skipping of values, and (b) the change in the scale with a difference of 100 (rather than the difference of 5, as in lower half of the Y-axis). The plot line itself has been marked with a '+' (plus) sign corresponding to these two changes. These changes have been done to emphasize the fluctuation in the frequency of unique authors, particularly corresponding to the paper counts of 0–40.

Of a particular significance is the tail of Table 2. The last row of the Table 2 signifies that there is 17 times that a unique author appeared in the papers. This means that this author has contributed 17 research papers either alone or along with others. Similarly, the second last row of the Table 2 indicates that there are two unique authors each of whom has authored 16 research papers.

If we treat the distinct authors with a greater number of research publications as important, this data provides a critical research finding as it presents the top scientists in the field. The pertinent data is presented in Table 3.

The criteria for inclusion of an author in Table 3 were, (a) the number of publications of the author should be high, and (b) the paper count should be at least a double digit figure (i.e. ≥ 10). The data in Table 3 is sorted on the paper count and hence it presents the top scientists of the field in the decreasing order as we move
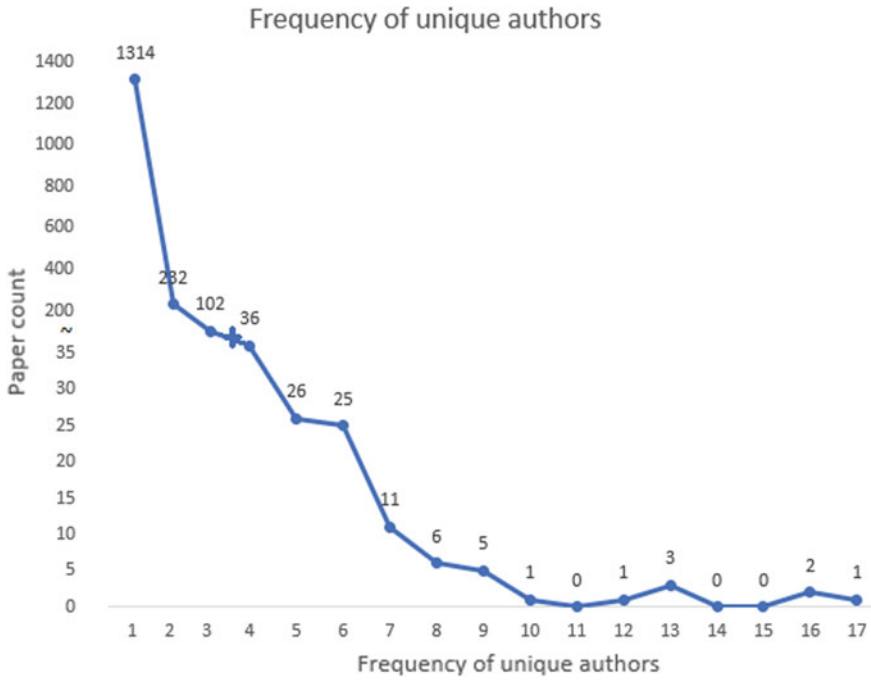
Fig. 2 Representation of paper count versus the frequency of unique authors

from first author to the last one in the list. However, we observe that it will be inapt to rank a particular scientist better or above than the other just based on the count of the number of publications. That ranking may consider various other factors like the citations of the researcher and whether the paper(s) were sentinel or not, just to name a few criteria. Further, the temporal factor for the rankings have not been considered here. For instance, one scientist could have achieved the top position in one decade while some other scientist could have done so in just a year. This is beyond the scope of our research work and hence we treat all authors listed in Table 3 as the top scientists of the database field. It is notable that these 8 scientists (which constitutes just about 0.45% of the total number of 1765 authors) have contributed more than one-tenth of the total number of publications of the field, for a period of more than four decades.

In order to confirm that the scientists listed here do have a remarkable contribution to the field of databases and out of curiosity we checked their details on GoogleScholar and the corresponding indices have been appended in Table 3. The data was last accessed on 19th May, 2022 14:30 IST. This data is also provided with an intention to present the readers of this paper with an additional information about these scientists. The grand total of the number of citations as well as the i10-indices have also been provided in Table 3 for the listed scientists. The total of h-index is not provided as it is statistically irrelevant for any scientific interpretation.

Table 3 Distinct authors with top counts of computing database papers during 1976 to 2021

Sr. no	Author	Paper count	Citations	h-index	i10-index	GoogleScholar profile URL
1	Christian S. Jensen	17	34,099	92	366	https://scholar.google.com/citations?user=wo20cPYAAAAJ&hl=en
2	Yufei Tao	16	20,499	69	128	https://scholar.google.com/citations?user=3FmJBHkAAAAJ&hl=en
3	Wenfei Fan	16	13,259	61	146	https://scholar.google.co.in/citations?user=u0S6ofAAAAAJ&hl=en
4	Philip A. Bernstein	13	43,181	82	200	https://scholar.google.com/citations?user=6OEYXEIAAAAJ&hl=en
5	Ronald Fagin	13	38,271	78	122	https://scholar.google.co.in/citations?hl=en&user=ohL-Y50AAAAJ
6	H. Garcia-Molina	13	89,695	141	437	https://scholar.google.co.in/citations?hl=en&user=bAa_kAAAAJ
7	Phokion G. Kolaitis	12	9859	49	99	https://scholar.google.com/citations?user=cqnovfEAAAAJ&hl=en
8	Leonid Libkin	10	11,170	55	138	https://scholar.google.com/citations?user=4q-MIB0AAAAJ&hl=en
Total	8	110	260,033	–	1636	

In order to observe the trend in the length of the title of the research paper, we first calculated the title length for each of 1031 papers. This length (calculated by counting the number of characters in the research paper's title) was then aggregated for each year, i.e., the summation of paper title lengths was calculated year-wise. Figure 3 presents the plot of year-wise aggregated database field's research paper title length against each year.

Though the observations on the fluctuations of the length of the titles of research papers will be statistically and scientifically rather irrelevant if considered year-wise, the important derivation from this plot is the clear and significant linear upward moving trend. This is an indication that over the four decades, the authors have tilted
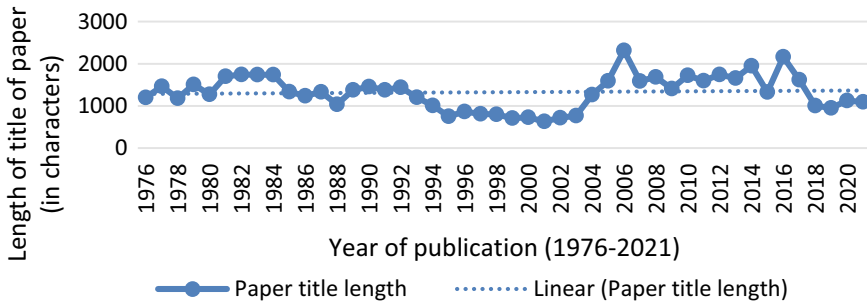
Fig. 3 Trend of paper title length for the period of 45 years

towards and preferred the longer titles of research papers. One possible reason behind this could be the motivation of the authors to emphasize a particular area of the field of databases with more specific keywords. Also, as time passes, the research becomes oriented towards and more focused on subareas and sub-sub areas. On the sidelines, the yearly average length of research paper titles was found to be 1326 characters.

Figure 4 presents the graphical chart of the number of papers plotted against the years from 1976 to 2021. The graph indicates that over the period of all of these years, the number of published papers year-wise has remained almost consistent with an average rate of nearly 23 papers per year. The trend line also indicates that this rate has been maintained consistently, with exceptions of 11 papers and 38 papers as extreme low and high values respectively in years 2002 and 2006. Figure 4 also displays the number of authors plotted against the 46 years. Though the number of authors is almost parallel in trend with the number of papers, there is a clear upward linear trend in the number of authors with the passage of time. This indicates that the recent researchers have more collaborations. Unlike Maltseva and Batagelj [12] who proved that the number of single authored papers has decreased since the 80s, we have proved that this holds true even if the time period from the 70s is counted. The proposed results of the present research work for the field of computing databases are aligned with the results of earlier and contemporary researchers like Maltseva and Batagelj [12], Plummer et al. [14], Shaffer [15], and Castelvecchi [17] for the respective fields of social network, pharmacy, medicine, and physics. Further, the green arrows in Fig. 4 indicate that the number of authors for a given paper is increasing with time. This is particularly true for papers published after 2003. The analysis of the reasons behind this sudden change in trend is beyond the scope of this paper. The minimum and maximum number of authors were found to be 26 and 121 respectively for the years 1995 and 2006. It is notable that the maximum number of papers were also found for the year 2006. The average number of year-wise authors was found to be almost 61.

The proposed results have a tremendous scope of applications in the field of scientometric analysis which is used for the objective mapping of the technical and scientific knowhow of a particular field [18]. The field of interest for the present research work is that of the computing databases. These results are also useful for
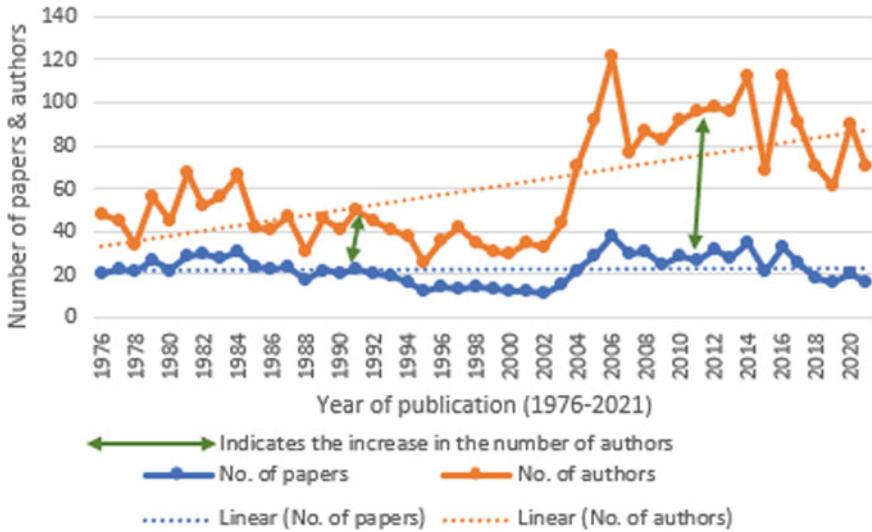
Fig. 4 Comparison of trends of no. of papers and no. of authors for the period of 45 years

stylometric studies where particularly the author attribution issues could be addressed with the help of statistical information presented here. Another area of very specific applications of the proposed results is that of bibliometric studies where in the statistical evaluation of the published works is presented as a tool to measure the possible impact of publications in the scientific community [19]. Further, the presented results are of utmost importance for agencies providing research sponsorships, scholarships, funding, and grants, keeping in view the past trends and the predicted estimations of research publications, collaborations and possible impact of research.

5   Conclusion, Limitations and Future Work

The present work ambitiously attempted to analyze the evolutionary developments of more than four decades of research in the field of computing databases. Though there are many major and minor findings presented in the previous section, we present a brief of the selected results and findings in this section. Based on the comprehensive and exhaustive analysis, we conclude that nearly 20% of the research papers are sole authored while 52% papers of this field are authored by either one or two authors. Nearly three-fourth of the papers are authored by a maximum of 3 authors whereas 10% of the total papers have number of authors more than 4. Almost, 75% of the times, a unique person was present in the author list of the research papers. This indicates that the field attracts a good number of emerging researchers. Similarly, considering the number of characters in the title of the research paper, it is concluded that the average length of the research paper title is more than 1300 characters.

An important inference derived from the analysis is that the total number of authors per paper depicts a linearly increasing trend. This is true for the trend of the title of the paper length as well. Hence, for the first time in the research community, we have formally and empirically proved that the future research papers will have longer titles and a greater number of authors. We attribute the greater number of authors to the possible pressure to publish which is very often linked with the professional promotions. Additionally, increased collaborations through digital networks, inter-disciplinary research, and the sheer volume and intricacies of research effort could be the other factors contributing in this direction. The recent shift with most of the journals converting to a model allowing free reading of the articles while charging ever increasing Article Processing Charges (APC) for publication could also be a factor necessitating more collaborations. For the field of computing databases specifically, based on the statistics analyzed in the present research work, this could be estimated to be more than 1400 characters on an average for the paper title length, and more than 4 authors, on an average, for the author list. There are nearly 0.50% authors who have contributed more than one-tenth of the total number of research papers in a period of more than four decades in the field of computing databases. For the first time in research community, it is hence claimed that this leads to the possible applicability of Zipf's law as well as the ABC rule of inventory management to the field of research publications as well, when compared with the corresponding number of authors.

One of the limitations of the proposed research work is that the top scientists of the field of databases may differ if a different criterion or a set of criteria is considered for ranking. This is so as for the present research work only the number of publications have been considered. Also, the results reported here are based on the research papers considered for the present research work and we do not claim that the presented list is exhaustive. However, the present research work definitely provides a glimpse on the direction in which the field of databases is moving. It is notable, that though the predictions about the increase in paper title length and the number of research authors are for the specific field of computing databases, we advocate that a similar increasing trend in the paper title length as well as the number of authors will also exist in the other fields. However, the exact averages could be predicted based on statistical analysis of the data of many decades for the respective fields. We have already started working in this direction for further work. Additionally, we have also started to consider the expanded scope of publication houses. This will provide us with a more comprehensive list of top scientists as well as the refined trends of paper title length and number of authors in the publications of the field of databases.

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A Brief Research Study of Wireless Sensor Network, Its Application and Routing Schemes

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Abstract Wireless Sensor Networks act as a vital part in revolutionizing the world by its sensing technology. In Wireless sensor network transmission of information is done wirelessly. Wireless Sensor Networks is a dynamic technology which has a continuously growing range of applications. In WSN, the sensor nodes have finite energy resources, and their storage and processing capabilities as well as their transmission range are also finite. In wireless sensor networks Routing protocols are responsible for maintaining the path in the network and have to provide valid multi-hop communication under these conditions. In this research paper wireless sensor network and its various applications, challenges and routing schemes of WSN discuss with the intention of spreading its concept among the research community so that it could be applied in more innovative fields.

Keywords Wireless sensor network · WSN applications · Challenges · Routing protocol and its advantages and disadvantages

1 Introduction

Current advancement in technology in electronics and wireless communication has brought the use of WSN in to real life. We can see its use everywhere like agriculture, environmental monitoring, surveillance and security, smart buildings, animal tracking, health care monitoring, disasters management and emergency services etc. WSN is collection of nodes which contain radio Trans receiver, microcontroller and sensor as shown in Fig. 1. Sensor nodes are small in size, energy efficient and low cost devices which are used to collect different data as per application requirement.

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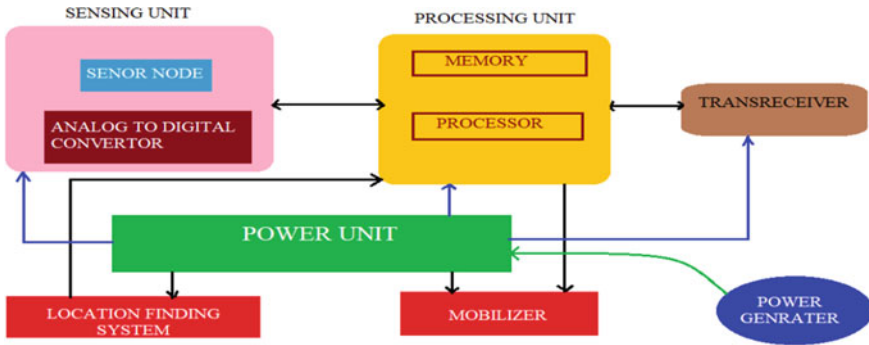
Fig. 1 Sensor node components
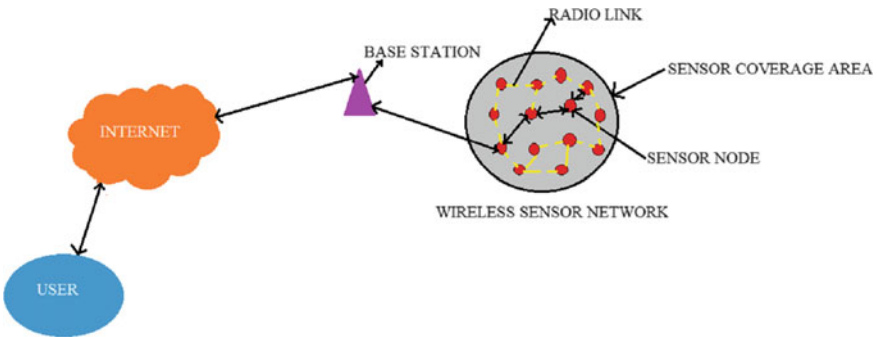
Fig. 2 Architecture diagram of WSN

In built Processor is used for computation propose and a transceiver to communicate with other nodes or base station. Most crucial unit in sensor node is power unit. Power generator, mobilizer and location finding system are application based optional subunits [1, 2].

Figure 2 shows the architecture of WSN which contain sensor node, base station and user. There is radio link exist between nodes. Sensor node sense data and communicate with its neighboring node, send sensed data to base station. Each data collected by the base station and sends this analyzed data to user using internet. Medium access control and routing protocol are play major role in WSN. Routing protocol provide optimal path for sending or receiving data from source to destination [3].

2   Application of WSN

Monitoring and tracing are two main categories of wireless sensor network application. Some Monitoring based application are Structural and seismic, wellness

and health, environmental monitoring, location monitoring and power monitoring. Tracking of animals, objects, human, vehicles are few tracking based applications. Let's discuss some examples of WSN application that have been installed and tested in environment monitoring. Sensor nodes collect various data from environment using different type of sensor like temperature, humidity, light, sound, particulate matter, different gas concentrations etc. [2, 3].

WSN application can be used in following areas:

2.1 Military Application

WSN has appeared as a distinguished tool for military application. It can be used as intrusion detection, monitoring number of parameters like gathering of information, provide smart logistic support in undetermined deployed area, as a detection of attack, surveillance in battlefield and gather information. Current trend and continuous evolution of technologies in the microelectronics area has lead to modeling of micro electro mechanical system (MEMS). These systems had overcome the limitations of system on chip technology. It provide sensing abilities of physical parameters and control of the real world both by means of actuators. Miniaturization of Digital circuits have reduced the circuitry into a single chip and minimized the fabrication cost. For Detection of object of interest from distance, Radio detection and ranging, ultrasonic sensor and Light Detection and Ranging are used by nodes in wireless sensor network. Surveillance needs ability to detect, identify, track and categorize enemy and give priorities to these according to task performed. Fast exploitation, error acceptance, self organization and discreetness of sensor network make them a very supportive sensing technique for military application [2].

2.2 Environmental Monitoring

Wireless sensor network has vast use in environment related application like coal mining, tsunami detection, forest fire detection, earthquake detection, gas leakage prediction, cyclones, volcanic explosion, water quality and rainfall range and so on. WSN gives fast detection and can predict natural disasters, that is helpful for saving human lives and avoid property damages. Environment monitoring system measure environmental parameters like pressure, temperature, sound, light and humidity [2, 4].

2.3 Water Monitoring

Water from oceans, rivers, lakes or glaciers is important factor in human life. WSN can play a vital role in monitoring our water sources. In water quality monitoring number of parameter are monitored such as dissolve oxygen value, level of water, PH level and other dissolved gases discuss in [5]. Marine environment monitoring is also a important WSN application as discussed [6] in this paper. A cyber physical system which is also called as pipe sense is an in pipe process for monitoring water which is done using radio identification dependent wireless network. Fish culture water quality is monitored using CDMA base remote wireless water quality system. For controlling the pollution of fish farm, under water wireless sensor network with ground based wireless sensor node is designed.

2.4 Air Monitoring

For air pollution of the environment and human lives Air is important element. In occupied regions WSN is utilized for air quality monitoring which measures dangerous air pollutants and other harmful particles present in the air in order to control serious disease and risk the people health. Now a day's WSN is deployed to measure Air quality index which measures particulate matter concentration in air outside [7].

2.5 Disaster Monitoring

Mass destruction of human lives and property happened due to earthquake in India on 26 Jan 2001, this was the most awful earthquake that disturbed not only India but also its neighboring countries, number of people lost their lives and property losses were unexplainable. WSN can predict common disasters causes in real time and give alert to control and minimize the damage and fend off disaster. In coastal region WSN is utilized under water for tsunami detection. Forest fire is also disaster which kills animals and destroys vegetation. To prevent this disaster WSN is deployed in forest area to monitor real time parameter to stop forest fire [8]. This includes tradition, methods (Patrols, watch towers, satellite) to a WSN using Zigbee protocol [9]

2.6 Industrial Application

In engineering communities industrial automation application has high potential benefits. WSN is utilize in electric machine for their energy usage, evolution and condition monitoring in oil refineries chemical plants and paper mills [10].

2.7 Smart Building

Smart building is another wide WSN application. Smart homes Indoor and outdoor environment is automatically controlled like electric appliances and other gadgets using WSN in real time.

2.8 Medical System

Recently WSN in field of Medical is unavoidable. Various devices has been developed which are small in size and easily wearable like oxymeter, two lead electrocardiogram (EKG) that measure oxygen level and heart rate. Medical field study and research using WSN is explained in detailed in. Haward university design a software infrastructure which is scalable and name code blue for wireless health or medical diagnosis [11].

2.9 Vehicle Monitoring

WSN application is widely used in smart transportation for improving safety and quality Vehicle transportation. Sensor and cameras are used to detect the traffic flow to minimize traffic jam and also monitor actionable activities in critical infrastructure like railway stations, air ports and highways.

3 Challenges and Related Recommendations in WSN

See Table 1.

Table 1 Wireless sensor network's challenges and issues

Sr. no	Challenges	Issues
1	Security	WSN faces various problems when we talk about security of data. Security requirement that concentrate on making WSN secure are confidentiality, secure management, authenticate, quality of service, encryption and integrity. Confidentiality should guarantee that personal and confidential information to be protected and secured from illegal extruder/expulsion [12]
2	Power consumption	Most of the literature in WSN is align on this feature. Despite current innovation in the field of wireless sensor networks, WSNs still require large amount power from energy constrained batteries for information sending and processing
3	Limited storage	The wireless sensor nodes have finite memory and computational capacity. In addition, For a long time the WSNs have been applied in inaccessible and harsh environments. Thus, the resource limitation of the wireless sensor nodes is one more challenge for WSNs-based applications. Memory of sensor node depends on size of the network which carries the overall information of network topology
4	Coverage and connectivity	The connectivity of the sensory data from sensor nodes to the sink is also major issue in WSNs, Means the capability of applications to connect with the sensors, people and cloud. Connectivity is dependent upon deployment of sensor, node type and mobility of node
5	Data aggregation techniques	Wireless Sensor Networks are installed in an area to sense the information. These sensor nodes sense the information and send same data via different routes to sink node. Due to this redundancy at sink node increases. Sink node wastes most of its energy in processing redundant packets. Prolong the lifetime of network and save the energy of sink node and there is need to eliminate redundancy
6	Sensor deployment methods	Wireless sensor networks performance widely depends on the sensor nodes deployment as well as their lifetime which is determined by the power consumption/utilization. Most current attention, however, has been paid to power-efficient deployment
7	Routing protocols	Node's mobility, resource constraints, and hidden terminal and exposed terminal problems are major issue for developing a routing protocol for ad hoc wireless networks

4 Routing Protocol in WSN

Routing is a one of the most difficult factor and mobility causes continual network topology changes which require highly robust and flexible technique to search and maintain routes and sending data from one node to another in networks. When nodes
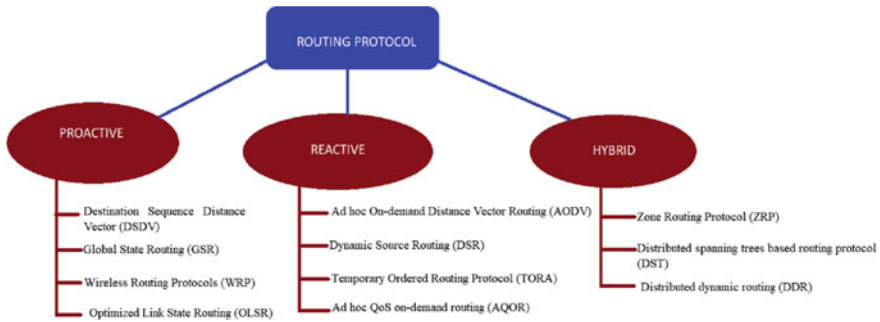
Fig. 3 Classification of routing protocol

in the network frequently change their location, the established paths between nodes may break and the routing protocols must dynamically find other fresh and shortest routes. Various routing protocols in WSN have been proposed for stability, precision, speed, reliable, scalability, fairness, secure, robust, Quality of Service aware and power efficient routing protocols for a high density of frequently changeable network topology [13]. In a WSN, routing protocols classification is as table-driven/Proactive, on-demand/reactive and hybrid as shown in Fig. 3.

In proactive routing protocols routing tables are maintained by each node, which carry correct route detail of each and every node which is present in that particular network area. Routes are available in Proactive protocols the moment they are needed. Proactive routing protocols create control overhead in large networks and excessive control traffic when nodes move frequently. In reactive routing protocol/time driven routing protocol it is not necessary to maintain routing detail for every node in the network. When two nodes want to communicate only that time routing path is establishing between sources to destination node. Before transmitting data packet between sources to destination it will check first availability of path in routing table. When there is no availability of route then it will follow route discovery process to find the availability of routing path to destination means route discovery on demand and there is some finite latency in route discovery process. Routing path will be available till the communication is not terminated. Overhead in reactive routing is low compare to proactive protocol. Hybrid protocol include quality of both (the pair of) reactive and proactive routing protocol. It maintains characteristics of both i.e. minimize control traffic overhead and also minimize the route discovery delays by maintaining routing table [14].

5 Advantages and Disadvantages of Routing Protocol

See Table 2.

Table 2 Advantages and disadvantages of Routing protocol

Routing protocol	Classification of routing protocol	Advantage	Disadvantage
Proactive routing protocol	DSDV	Time to time updated routing path is available in routing table and broadcasted to all other neighboring nodes Its table maintains shortest and best path for data packets to destination which reduces space in table Loop free protocol. Unwanted traffic is avoided by this protocol using incremental update	Not beneficial for multipath routing Broadcasting of table information every time even when not required or no change so waste the bandwidth Overhead is high Not supported for large network and multi path routing
	GSR	Updates are localized	Overhead is high
	WRP	It chooses shortest path from source to destination and store past and future node value in table Path searching cost is low	It uses multiple tables which take more space Due to shortest path selection it generates complexity problem
	OLSR	Centralization is not required for routing Control overhead is reduced and low end to end delay This protocol is beneficial where long delay is not allowed for data packet transmission	Broken link need more time for again discovering
Reactive routing protocols	AODV	It is highly effective for dynamic topology due to on demand routing process	This protocol faces high latency problem during route discovery process
	DSR	Network overhead is low Use multipath routing	This protocol cannot find broken link Not supported for large networks Latency is high in route discovery process

Table 2 (continued)

Routing protocol	Classification of routing protocol	Advantage	Disadvantage
	TORA	Provide loop free routes Executes distributed Provide Multiple routes Routes are quickly established Overhead is minimized Provide optimal path	Route searching process produce delay When new route is established on demand then flooding messages occur
	AQOR	Channel utilization is high AQOR is a reactive Quality of service routing protocol, guarantee minimum end-to-end delay and bandwidth in Mobile Adhoc Networks	Every time when route failure occur which increase end to end delay
Hybrid routing protocol	ZRP	Retransmission is reduced ZRP has quality of both on demand and table driven routing protocol When node come in Zone area it uses table driven technique and when node not come in the zone area it uses path searching technique	Route searching is tough when routing zones are intersecting
	DST	No. of retransmission are reduced	Root node
	DDR	Zone organizer is not required	Favored neighbor may create congestion

6 Conclusion

Today, WSN finds enormous worldwide use due to its inclusion in various applications involve military surveillance, health and medical diagnosis, communications underwater, dangerous environment monitoring, disaster prediction, vehicle tracking, and investigation. This paper discuss briefly about introduction of WSN and its main applications highlighted along with the security aspects, challenges, issues and routing scheme in WSN. Each application has its criterion consideration and thus for different applications, discrete routing schemes have used by researchers. The challenges considered above should be accepted carefully depending upon application and network topology. WSN has revolutionized nearly each field of modern era and provide large scope of research in controlling different facet of human life.

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Comparative Study and Performance Analysis of Various Fibonacci Pattern of Solar Photovoltaic Tree—An Extensive Review

Sujit Kumar, Shakuntla Boora , **Poonam Singhal, and P. R. Sharma**

Abstract   In order to fulfill the world's energy demand and to reduce greenhouse gas emission, it is requisite to develop energy efficient (%) solution from solar energy to electrical energy. Since, the photovoltaic flat level module has an insufficient collection of solar energy. Inspire of this PV flat module technology has problem of land demands, effectiveness and shortfall of pleasant attractiveness. This paper basically gives overview of newly modified technology-solar photovoltaic tree that can overcome these challenges effectively. Fibonacci form of technique is used in solar photovoltaic trees for maximum energy transform in each direction. This review paper shows analysis of two kinds of solar photovoltaic trees form of on Fibonacci pattern, such as 2/5 and 3/8 phyllotaxis form of solar photovoltaic trees. The performance (o/p power and efficiency (%)) of the classical solar panel, 3/8 and 2/5 phyllotaxis pattern is studied and analyzed. Solar photovoltaic tree innovation generates good energy transformation since it requires only 1% of land in comparison to classical/classical flat module PV systems. This system also gives power extra than 10% with respect to classical PV system.

Keywords   Solar photovoltaic tree · Classical photovoltaic solar panel · Efficiency (%) · O/P (output) power · Phyllotaxis form · Fibonacci · Maximum power transfer theorem

1   Introduction

Solar radiation generated from sun can fulfill the energy demand of world either directly or indirectly. So we have to utilize solar energy in correct manner. Hence the main challenge is to extract the power from sun efficiently. Since in PV system electrical energy get generated due to irradiance, which is clean and sustainable energy [1]. As the energy demand goes on increasing day by day, solar energy will become most renewable energy source by the year 2060 [2]. Electric Power generated

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from the solar photovoltaic tree gives extra power because we know location of the sun in sky changes all over the day. In order to generate large power from solar, it requires large area of land to install solar panel, which is major concern in world. So, In order to install large number of panels there is a new technique called solar photovoltaic tree. The appearance of solar photovoltaic tree is similar to tree in nature. As it is observed that when the tree is in nature, there is a leaf attached to branches of stem, similarly in the solar photovoltaic tree there is solar panels attached to the branches. Solar photovoltaic tree used the theory of phyllotaxis form, which refers to spiral way of orientation of leaf on stems. But in modern solar photovoltaic trees, Fibonacci pattern used so that there is maximum accumulation of sunlight all over the day. The major benefit of using solar photovoltaic tree is that it acquire only 1% of land in comparison to classical solar photovoltaic system [3]. Since the earth suffer from land scarcity, so we can't left future of renewable energy on classical solar panel. We have to find ways to overbear power lack as population goes on increasing day by day. Sun emit the energy in 3–4 min is approx. equal to whole world energy demand in one year. Fibonacci pattern is introduced by Italian scientist Leonardo Fibonacci. In Fibonacci pattern each number present in the series is addition of two previous numbers [4]. The supremacy of solar photovoltaic tree is that solar module used there has different orientation in space, but in classical solar panel there is fixed orientation. In this paper design and analysis of two solar photovoltaic tree models having 3/8 and 2/5 phyllotaxis pattern are compared with classical systems [1, 3].

2   Literature Review

Solar photovoltaic tree is innovative, unique and enormous renewable source having nearly zero emission. It is considered as way to make maximum use of energy from sun. For the maximum transformation of energy connected in each direction, there is use of technique called Fibonacci technique. The orientation of panels in the solar photovoltaic trees with branches of solar photovoltaic trees in such a way that there is only one solar panel at each node, this type of orientation is known as spiral phyllotaxy pattern. Spiral phyllotaxis form gives advantage that there is no such shading effect in all the panels from each other which cause the more accumulation of sunlight throughout the day. This paper showed the performance of various phyllotaxis form and show in graphical form [1]. Sasmita et al. [5] mentioned in her paper that In order to get maximum output from solar photovoltaic tree, phyllotaxis phenomenon is to be implemented so that their performance is improved. Sasirekha et al. [6] did regression analysis and compute the value of solar radiation of random forest. In this paper there is comparison of actual value obtained and predicted value of solar irradiation. Shahida et al. [4] showed the test of comparison between solar photovoltaic tree and classical solar system. In this paper there was discussion of Fibonacci based solar photovoltaic and avoid shading effect of branches and leaves. Kishore et al. [7] mentioned in his paper about maximum power point tracking algorithm in order to take the maximal power from the panel. Solar radiation and

temp. (temperature) is monitored continuously. This paper showed the design and simulation of MPPT by using DC-DC converter. Duque et al. [8] designed artificial photovoltaic system for charging of phone in city at Medellin Rahmi et al. [9] presented various algorithm for the prediction of solar radiation with the help of machine learning. This paper presented algorithm which develop minimum R.M.S error. Siddhesh et al. [10] mentioned in his paper about generation of solar power with PWM based boost converter and HERIC inverter topologies. A. Kavas et al. [11] described working concept of solar photovoltaic tree along with calculation and the technical description. Avdic et al. [12] described about opportunity to build solar photovoltaic tree. This research paper convey about implementation of solar photovoltaic tree in city of Sarajevo. The major role of that project is to get satisfying o/p which includes following role (street lightning, charging of mobiles and laptop etc.), beauty, durability and economic. Mukesh et al. [13] gave the ideas of using nano leaf in order to maximize energy from sun, thermal and power die to piezoelectric. Rahul et al. [14] compared the panels in matrix way and in solar photovoltaic tree at particular location and comes out with conclusion that solar photovoltaic tree took less space. Janapati Balaji et al. [15] placed the solar panel at different area at various inclinations and their performance was calculated and then compared with the help of simulation. Asai et al. [16] made module in 3-dimensional so that there is efficient transformation of solar energy and with help of simulation, they found that it produce significant amount of energy. Toshifimi et al. [17] mentioned that PV module in 3-dimensional structure and using Fibonacci number is found to be effective. This paper shown their performances through the simulation. Marco et al. [18] exhibited that absorbers and the reflectors integrate in the lack of sun tracking's in order to build 3-dimensional PV structure which generate the energy density by the factor of around 20 with respect to classical solar panel. Yachi [19] designed the 3-dimensional model of solar panel with the help of Fibonacci number technique and found it more efficient. Suzumoto et al. [20] proposed 3-dimensional model using Fibonacci number and found that it increases its performances. They proved their explanation using simulation. Maity et al. [21] used green power for soap up sun rays, they used SPV (silicon photovoltaic) method and compare with classical solar panel. Pavan et al. [22] told that there solar pv tree has limited life expectancy so that they propose heat and chemical treatments using the method EOL for the recovery of material from phyllotaxis based solar PV trees. Ahmed et al. [23] discussed hybrid PV electromechanical having MPPT algorithm. They verified their system through simulation and shown the performances of system. Manoj [24] proposed the design of more than one layer solar power PV. They proposed leaf type design and shows the performances of system through simulation technique. During the evaluation efficiency, regulation (thermal), emission of carbon is also considered. Pavan et al. [25] gave review of performance of solar tree in various effect energy, economy and environmental. Formon [26] studied the failure of 11,000 PV module installed in different area of united state(1977–1980) and found that failure was due to cracking of cell due to internal stress soldering joint failure and splitting of interconnect. Aidan et al. [27] observed the way by which leaves grew from oak trees showing Fibonacci sequence. This paper showed the design tree according to sequence of oak tree. In

Fig. 1 Innovative solar photovoltaic tree

place of oak leaves there is solar panel. Jyoti [28] discussed different design of solar tree and compare it with classical solar panels. Takahashi et al. [29] proposed method related to scattering of light and told about single stage FPM (Fibonacci photovoltaic module) and multi stage FPM to make system effective. Suto et al. [30] made simulation model in order to design the shadow effect of PV solar cells. Characteristics and performance are shown with simulation model. As the number of stages gets increases then power generating capacity will increase also (Fig. 1).

3 Block Diagram of Working of Solar Panel

The block depicts the process of conversion of solar energy. As we know solar panel gives electrical output. The electrical energy has to be stored in battery with the help of charge controller. The purpose of charge controller is to keep battery safe in condition of overcharging and under charging. Then DC power which is stored in battery has to converted in AC with help of inverter and then it gives power to load.

4 Designing and Performance Equation of Different Models of Solar Photovoltaic Tree

The pictorial diagram demonstrated in Fig. 2 is 3/8 phyllotaxis form pattern. In this paper there is study of two kinds of solar photovoltaic tree form (3/8, 2/5) and classical solar panel. The design of 3/8 phyllotaxis form of solar photovoltaic tree consist of eight solar panels as the leaves as we see in tree in nature.

There is use of polypinyl chloride (PVC) pipe as the stems. It consists of eight aluminium rods of different length in order to concatenate solar panels to trunks. It consists of rectangular base to grip the solar photovoltaic tree and wires in order to concatenate solar panel with external circuits. For the design of 3/8 phyllotaxis form of solar photovoltaic tree, there is use of spiral phyllotaxis. This means spiral should
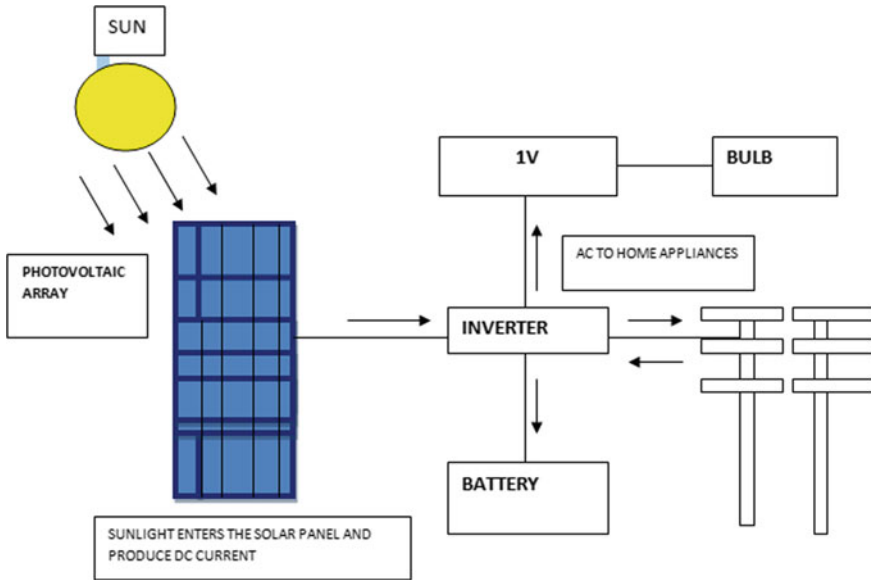
Fig. 2 Block diagram of working of solar panel

be done such that it take three helical curl around the main trunk in order to enclose all 8 branches as demonstrated in Fig. 3. So, angle between the various branches given as following.

$$\frac{3}{8} \times 360° = 135$$

As we see the design of 3/8 phyllotaxis form, similar is the construction of 2/5 phyllotaxis form of solar photovoltaic tree. So, angle between the various branches given by following (Fig. 4).

$$\frac{2}{5} \times 360° = 144$$

5 Performance Equations

For solar panel performance (O/P power and efficiency (η) depend on the climate. Temp. of solar panel depends on the amount of incident solar irradiation.

The O/P power obtained from the solar panel is determined by [1]

Fig. 3 Pictorial diagram of 3/8 phyllotaxis form of solar photovoltaic trees [1]
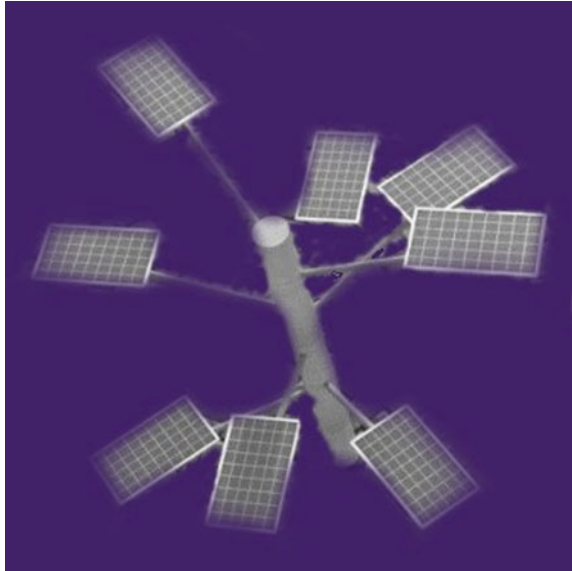
Fig. 4 Pictorial diagram of 2/5 phyllotaxis form of solar photovoltaic tree [1]

Where

$$P_{OUT} = \frac{FF*V_{OC}*I_{SC}*GT_{ref}}{G_{ref}\left[\log G_{ref} - \log G\right]T_{cell}}$$

G represents solar radiation, G_{ref} represent reference solar radiation, T_{cell} represent cell temp. and T_{ref} represents the refrence temp. at 25° celsius.

Further Fill factor represent quality criteria of PV module, which is defined as ratio of P_{max} and (V*I)

$$FF = \frac{V_{OC} * I_{sc}}{V * I}$$

When the temp. of cell increases then efficiency (η) got decreases.The term efficiency (η) is the ratio of electrical power o/p to solar power falling on surface of PV cell.

$$\eta = \frac{p_{out}}{p_{in}} = \frac{V_{oc} * I_{sc}}{G * A}$$

where p_{in} = G*A and A = surface area of cell

6 Results Obtained from Case Study (Technical Description of Classical Solar Panel, Component and the Measuring Instruments Used in Experiment) [1]

PV module: Nature—Poly Crystalline module having technical description as following.

- Max(Maximum) power rating = 3 W
- I_{sc} = 0.38 A
- V_{OC} = 10 V
- Voltage (Rated) = 8.8 V
- Current (Rated) = 0.34A
- Weight of module = 1.150 kg
- Dimension of module = 185 × 185 × 17 mm

Module analyzer (Model no-MECO 9009 (60 V, 12A) used to measure o/p power Solar power meter (Model no—TM 207) used for measuring solar irradiation.

Humidity temp. detector (Model no—FLUKE 971) used for measuring the ambient temp.

Anemometer—Used for measuring wind speed.

Data logger—used for storing the data.

Above experiment was done at Patnagar in Uttarakhand (India) during summer season. Here data has taken every 30 min in between 10 AM to 5 PM with the help of data logger in clear day.

Table 1 depicts that max solar insolation comes in noon times and minimal solar insolation in evening times. Table 2. Depicts that max solar insolation comes in noon times and minimal solar insolation in evening times

Since the performance parameters of this PV system depend upon atmospheric condition and insolation. All the values taken in difference of 30 min and following parameters were recorded.

6.1 Ambient Temperature and Solar Insolation

It shows that how solar radiation and ambient temp. are varied in different solar panel in 2/5 phyllotaxis form and 3/8 phyllotaxis form as demonstrated in Tables 1 and 2.The table depict that max solar insolation comes in noon times and minimal solar insolation in evening times.

6.2 O/P Power of PV System

Figure 5 depicts that o/p power show increment before noon and decrement in second half. The avg. (average) o/p power of 3/8, 2/5 solar photovoltaic tree and classical solar module are 0.34, 0.30, 0.28 (in p.u.) respectively. This shows that the 3/8 phyllotaxis form gave maximal power output i.e. 0.34 with respect to 2/5 phyllotaxis pattern and classical solar panel. So, 3/8 phyllotaxis form gave 11.5% extra power in comparison to 2/5 phyllotaxis form and 18.85% extra than classical solar panel.

6.3 Relative Humidity

Figure 6 depicts inverse relationship between both parameters. When ambient temp. gets its maximum value at that time relative humidity has minimum value.

6.4 Efficiency (%)

0.3/8 phyllotaxis form shows (Fig. 7) better efficiency (%) than 2/5 phyllotaxis form and classical solar PV module. Although 2/5 phyllotaxis form of solar photovoltaic tree and classical solar module has nearly same efficiency(%) 0.3/8 phyllotaxis form of solar photovoltaic tree has efficiency(%) of nearly 54% extra with respect to

Table 1 Changes in solar irradiation on every solar panel and ambient temperature of 3/8 phyllotaxis pattern

Time (hr)	Panel no-1	Panel no-2	Panel no-3	Panel no-4	Panel no-5	Panel no-6	Panel no-7	Panel no-8	Ambient temperature
10:00	792	997	848	703	853	933	858	578	30.6
11:00	968	1071	1039	883	1001	1012	1015	776	35
12:00	1028	1019	1104	997	1038	992	1061	931	37.6
13:00	1027	909	1091	1041	1019	912	1014	1023	39.2
14:00	827	678	963	969	831	716	859	1001	41.2
15:00	729	498	834	879	705	523	742	935	43.6
16:00	543	289	674	751	518	308	581	806	42.4
16:30	361	191	538	609	369	201	452	663	41.6
17:00	293	139	427	507	267	163	368	59	41

Table 2 Changes in solar irradiation on every solar panel and ambient temperature of 2/5 phyllotaxis pattern

Time (hr)	Panel no-1	Panel no-2	Panel no-3	Panel no-4	Panel no-5	Panel no-6	Classical sol radiation	Ambient temperature
10:00	801	831	929	902	642	791	782	32.2
11:00	983	989	1022	974	811	968	950	35
12:00	1066	1046	971	901	931	1015	980	37.6
13:30	1059	1018	939	858	949	1018	970	39.2
14:00	894	879	712	661	869	887	815	41.2
15:00	779	764	539	391	751	758	652	43.6
16:00	558	611	357	199	596	591	481	42.4
17:00	331	331	194	129	342	328	258	41
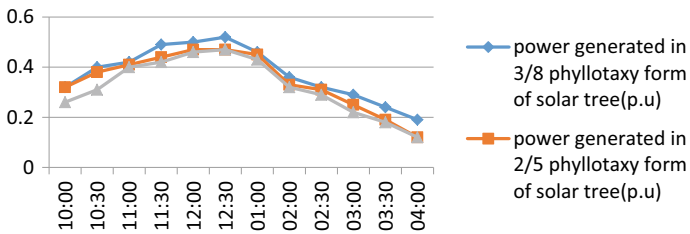
Fig. 5 O/P power in 2/5, 3/8 phyllotaxis form of solar photovoltaic tree and the classical solar panel [1]
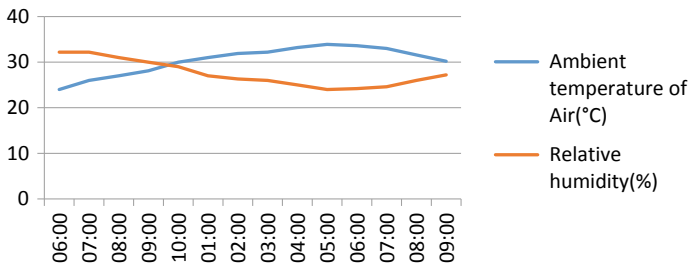
Fig. 6 Variation of air ambient temp. and the relative humidity (Hourly) [1]

classical and 46% extra with respect to 2/5 phyllotaxis form of solar photovoltaic tree.
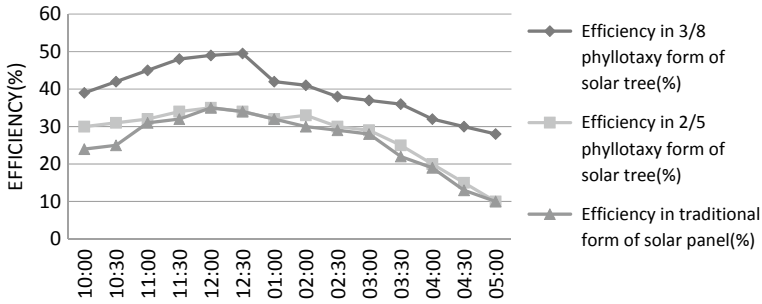
Fig. 7 Efficiency (%) of 2/5, 3/8 phyllotaxis form of solar photovoltaic tree and classical solar PV module [1]

7 Conclusions

By comparing the solar photovoltaic tree having Fibonacci pattern with classical solar panel, it will decrease the drawbacks of classical solar PV module. This technique helps to avoid the shading problem in solar photovoltaic trees. This paper shows the performance i.e. O/P power and efficiency (%) of solar photovoltaic tree form having Fibonacci pattern. It is observed that all these performances depend on climatic factor. Solar photovoltaic tree having 3/8 phyllotaxis form generate maximal o/p power in comparison to 2/5 phyllotaxis form of solar photovoltaic tree and classical solar panel. The 3/8 phyllotaxis form of solar photovoltaic tree gave 54% extra efficiency (%) with respect to classical solar panel and 43% extra with respect to 2/5 phyllotaxis form of solar photovoltaic tree. Relative humidity has inverse relation with ambient temp. Behind so many advantages there are disadvantages i.e. it will cause problem to eyes due to solar reflector, threats for birds and insects and high costs.

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Bird Species Identification Based on Images Using Residual Network

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Abstract Nowadays many of the bird species are found rarely, and it will be hard to classify the species of birds if found. For instance, in various cases, the birds may be of with various sizes, colors, forms and from the human viewpoints with various angles. This paper presents Bird species identification based on images using Residual Network (ResNet). In addition leverage pre-trained ResNet model is utilized as the pre-trained CNN networks with the base model for encoding the images. The process of determining the species of birds will involve several phases. The first stage involves an ideal dataset construction that is incorporated the images of various bird species. Next stage is image normalization where size of pixel will be processed. In this paper, the Caltech-UCSD Birds 200 [CUB-200-2011] data collection is utilized to train and test the presented model. 500 labeled data will be utilized for training purpose and 200 unlabeled data will be used to test the model. Final results show that ResNet model predicted at 96.5% of Accuracy and loss function with 15.06% of bird species. This approach will be performed over Linux operating system with the library of Tensor flow and utilizing the NVIDIA Geforce GTX 680 along with2 GB RAM.

Keywords Bird species · Caltech-UCSD · Linux · Residual network

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1   Introduction

Currently, the bird species identification is one of the most difficult activities certain times lead to uncertainty [1]. The birds can allow the humans for searching some organisms in the environment since they may respond very quickly to the variations of atmosphere (as an instance the insects over which they may feed). However collection and gathering the information about birds needs massive efforts from humans as well as most expensive techniques.

However, recent human actions that might vary from intrusions into their ecosystems to outright annihilation of their habitats have put these exquisite biological diversities under danger and this is combined with the natural events such as climate changes and glob warming have driven several species of birds to extinct [2]. It might be assessed that approximately 1370 species have imperiled with extinct that can total up to as closely 13% of the overall bird population. Despite the fact that a variety of birds species are often encountered, individuals have trouble identifying them whole population of bird. Despite the bird species which are seen normally, but their identification by the people will be difficult.

The human requires a lot of efforts for stockpiling the information of birds which will be cost effective. In this scenario, larger scale of bird's data processing is required to be provided by the system that serves and benefits the researchers, government agencies, etc. since the decades the ornithologists have been facing different kinds of challenges regarding bird species identification. In these scenarios, there must be a robust system that will give the larger scale of bird processing formation and serves a most valuable resource to the agencies of government, scholars, etc. [3]. In the same way, bird species plays magnificent role to find that the species belong to the bird's specific image. In order to identify the species of bird from a picture, the system must first identify the bird's components and exclude unrelated background information. Individuals may find it easy to recognize. For teaching the machine, enormous number of data would be collected and the machine is required to train for the classification of species of bird. The image classification process is to classify the objects using datasets and separate them as different types [4]. An ornithologist studies the attributes and characteristics of birds and differentiates them based on their living environment, biology, ecological influence, etc. The experts of ornithology identified the birds relying on Linnaeus: Family, Class, Species, Kingdom, Order and Phylum [5].

The ornithologists are facing various issues while identifying the species of bird since several decades. They need to learn about all the bird species like their genetics, environmental impact, distribution, climate, etc. Typically, an ornithologist will identify a bird based on the categorization that Linnaeus proposed, using characteristics such species, rank, state, order, rank, and family [6].

The major objective of this research is identifying the bird images and classifying them as concerned species while considering the certain objectives which are as follows:

- The main concern of ornithologist is to identify the species of bird.
- While studying the resources of bird species, in order to ensure safety which can't be avoided.
- By the protection of bird species prestige, assets and value is provided to the nation.

A conclusion is made while studying the earlier works that enough advancements are not done in order to classify the birds in accordance with advancements of DL (Deep Learning) [7]. Thus, to solve this issue with the hope of A conclusion is made while studying the earlier works that enough advancements are not done in order to classify the birds in accordance with advancements of DL (Deep Learning) [7]. Thus, to solve this issue with the hope of achieving desired promising results. The remaining work is arranged as follows: Sections 2 and 3 demonstrates the corresponding works and architecture models. Section 4 discusses the analysis of results. The paper will be concluded in the Sect. 5.

2 Literature Survey

Gavali et al. [8] presented a technique for bird species automatic classification which may split the actual signal in the segments taken as primary unit of recognition, the MFCCs can be computed by GMM and VQ (Vector Quantization) for finding the more number of GMM elements and VQ cluster number to every species. They achieved 8% of accuracy which is a better classification for 28 species of bird. Sadouni et al. [2] utilized the bird songs portions were altered using the wavelet technique. The precise order MFCCs for the first four orders have been determined. They utilized a neural network classifier on a database of 420 bird species, and their recognition rate was 73.42 percent. Zhibin et al. [4] explored various kinds of modeling methods for improving the classification of bird species using the records of its audio. The author utilized supervised methods for obtaining note models which are approximate from the acoustic features. These note models are utilized for recognition system creation using a phone n-gram statistical method which is designed for the applications of speaker recognition. This model is competitive than GMM if same acoustic features are taken into consideration as the baseline. Here 9 species of birds are utilized and one of its better achieved results is 16.5% error rate in all the considered songs. Yo-Ping and Haobijam [5] presented an audio classification method for bird species identification. This work demonstrates the speech recognition technique and novel developments in DL fields using nearest neighbor matching or DT (Decision Tree) utilizing extracted instructions. However all these sound based works are performed by supervised learning. Liu et al. [9] presented the DL methods performance comparison to recognize the birds from aerial images. Significant enhancements are done in recent time ob. identification and detection of objects with expeditious expansions in DL and computer vision fields, especially deep CNN (Convolutional Neural Networks). This work done on smaller-object detection in less resolution and performance depending on DL is accessed by a new dataset in order to identify the birds

rather than utilizing the normal datasets for the recognition of object. Salamon et al. [10] explored the classification methods of state-of-art for classifying the larger-vocabulary species of bird from flight calls. Especially the author contrasts a "shallow learning" method depending on the unsupervised dictionary learning and deep CNN which is combined with the data that is augmented. Noticed that two techniques has performed comparably over the dataset which contains 5248 flight calls spanning the 43 different species by outperform the MFCC baseline. Eventually shown that combining the techniques by the simple late-fusion model, the results are improved and obtained 0.96 as classification accuracy. Different kinds of works have been performed depending on bird species sound.

Molchanov et al. [11] developed an exceptional structure for focus on neural networks particularly CNN kernels, in which pre-trained networks change the tasks that are specialized and which are equipped with systematic inference and is mainly focuses on transfer learning concept. Lasseck [12] presented deep learning techniques for audio-based bird identification at very large scale, to prevent overfitting different data augmentation techniques are used.

3   Bird Species Identification

The block diagram of Bird species identification based on images using Residual Network (ResNet) is represented in below Fig. 1. Various bird species images are collected from CUB-200-2011 bird image dataset with 200 category images. 80% of total species images are utilizes as training the data and 20% of images are used for testing the model.

The collected image datasets have to be preprocessed before they can be used for training the model. First we scaled all the images to same size ration and using CV2 libraries the datasets of images will be converted as image pixel arrays. Next the input image is transformed as appropriate form for presented Multi-level Per- ceptron, it will be essential that the image should flatten into the column vector. Then output which is flattened is applied to feed-forward neural network, back- propagation is fed to each of the iterations of training. On the series of epochs, this model can be used for distinguishing the dominating and some lower-level features in the image and their classification by SoftMax classification model.

One of the most common collections of bird picture data is the CUB-200-2011 and it contains 200 categories of images. This dataset included the birds that are found mostly in North America. The CUB-200 dataset contains 11,788 pictures and annotations such as 15 components positions, 312 binary characteristics and 1 bounding box.

We have allocated 80% data for training the model and 20% of the data is used to test the validation set. However these training and validation set are chosen aimlessly from a dataset which is used for the process of fine-tuning.

Using Image Data Generator the images shall rescale, rotate and flip. All the images are maintained to a specific size (224*224). The gray scale image dataset is

Fig. 1 Block diagram of bird species identification
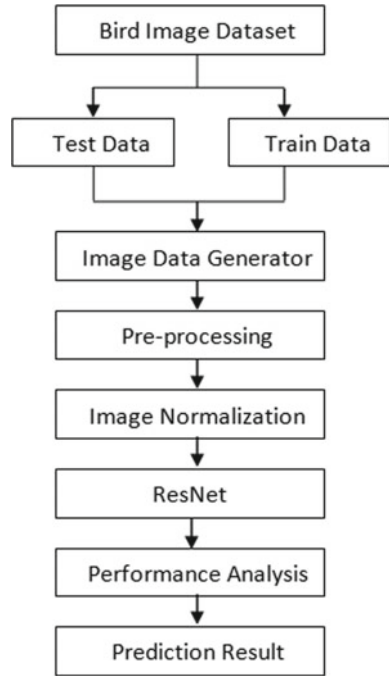
developed by pre-processing and is utilized to recognize the pixel-pixel by image and to reduce the size of image.

These functions will be aggregated and fed to the classifier. This will increase the time of processing by retaining the image quality.

ResNet 101 v2 model is utilized for training the image dataset. The ResNet is one of the specific kinds of neural network which is familiarized in 2015 through an article namely "Deep Residual Learning for Image Recognition". For solving the complex issue, certain additional layers in DNN (Deep Neural Networks) that will lead to improvement in performance as well as accuracy. The inclusion of these layers is necessary since they will gradually learn aspects that are more complicated.

Figure 2 illustrated the architecture diagram in which all the processes will appear. Firstly all the dataset is preprocessed where it is passed through Image Data Generator, all images are rescaled to particular size i.e. 224*224. The model is trained using Resnet architecture.

In addition, add some layers to presented model which are:

Flatten Layer which converts the given input into 1 dimension output, Batch Normalization layer which is used to scale the weights, activation function RELU is used to remove the negative values and SOFTMAX in the output which gives the highest prediction as output. Figure 3 represents the added layers.

Two different kinds of residual functions are there: directly the identity shortcuts (x) are utilized if input and output are having same dimensions. If the input dimensions of residual block and output dimensions of residual block are different
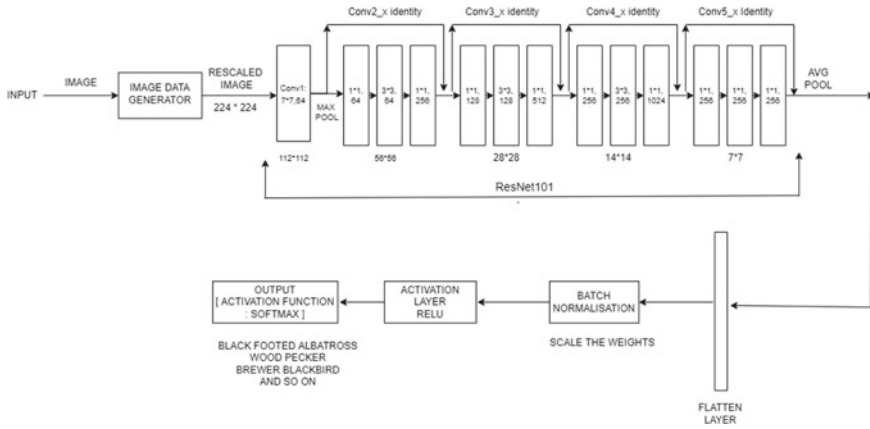
Fig. 2 Architecture diagram

then

$$y = (x, \{Wi\} + x). \tag{1}$$

If the dimensions are changed, then,

A. Still the shortcut can perform the identity mapping with additional 0 en- tries padded with increased dimensions.
B. The shortcut of projection will be utilized for matching the dimensions (by 1*1 conv) by below formula (Fig. 4).

$$y = (x, \{Wi\} + Wsx). \tag{2}$$

4 Result Analysis

This section demonstrated the experiment over CUB-200 image datasets and their evolution results. The NVIDIA Geforce GTX 680 graphics card, which has 2 GB of RAM, and the operating system (OS) Ubuntu 16.04 are used to do this practical testing.

Firstly image is uploaded and different alignments like beak, color, head, body and entire image from a file is considered. Every alignment is applied for functions extraction from network multiple layers through the conventions deep network. After its representation the image is considered. At last the classified results (i.e. attributes will be pooled and forward to classification model) are generated and species of bird is found.

```
Model: "sequential"
_____
Layer (type)                 Output Shape              Param #
=================================================================
resnet101v2 (Functional)     (None, 7, 7, 2048)        42626560

dropout (Dropout)            (None, 7, 7, 2048)        0

flatten (Flatten)            (None, 100352)            0

batch_normalization (BatchN  (None, 100352)            401408
ormalization)

dense (Dense)                (None, 2048)              205522944

batch_normalization_1 (Batc  (None, 2048)              8192
hNormalization)

activation (Activation)      (None, 2048)              0

dropout_1 (Dropout)          (None, 2048)              0

dense_1 (Dense)              (None, 1024)              2098176

batch_normalization_2 (Batc  (None, 1024)              4096
hNormalization)

activation_1 (Activation)    (None, 1024)              0

dropout_2 (Dropout)          (None, 1024)              0

dense_2 (Dense)              (None, 4)                 4100

=================================================================
Total params: 250,665,476
Trainable params: 207,832,068
Non-trainable params: 42,833,408
_____
None
```

Fig. 3 Layers in proposed model

Fig. 4 Building block of
residual learning
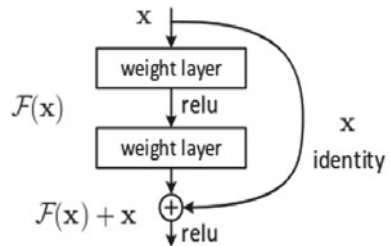
ResNet 101 v2 model is utilized for training the dataset of image. This presented model achieved 96.5% accuracy with test accuracy and 15.06% of loss function. Figure 5 represents the plot drawn for accuracy and loss function. It is clear that the loss is minimum (Figs. 6 and 7).


```
plt.plot(history.history['accuracy'],c='red')
plt.plot(history.history['val_accuracy'],c='green')
plt.title('Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['train','validation'],loc='lower right')
```

```
[ ] plt.plot(history.history['loss'],c='red')
    plt.plot(history.history['val_loss'],c='green')
    plt.title('Loss')
    plt.ylabel('Loss')
    plt.xlabel('Epoch')
    plt.legend(['train','validation'],loc='upper right')
```

(a) Accuracy   (b) Loss

Fig. 5 Accuracy and loss curves

Fig. 6 Predicted output
(Brewer Black Bird)

Fig. 7 Predicted output
(Groove Billed Ani)
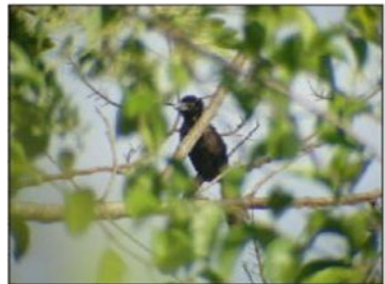
5 Conclusion

Birds Species identification is one of the challenging task for Ornithologists. In this paper, Bird species identification based on images using Residual Network (ResNet 101 v2) is described. CUB image dataset is used in this method which contains 200 category images. These bird species are performed by the findings as test images. This presented system achieved 96.5% of accuracy and 15.06% of loss function while identifying the bird species.

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Inclusion, Assistive-Technology and Teacher-Preparedness: Empirical Evidence from India

Shilpi Saha and Deepali Mallya

Abstract The overarching purpose of this research is to critically evaluate the evolving interaction between governmental policies and processes in the implementation of Assistive Technology (AT) for inclusive education. The authors primarily assess the teachers' knowledge and skills to employ inclusive pedagogy, specifically through the use of AT in inclusive classrooms. This study employs quantitative analysis to investigate the knowledge and skills of teachers in inclusive classrooms. Data were collected from 200 teachers across India. Partial least squares (PLS)—Structural equation modeling (SEM) was used to test the proposed hypotheses. Specifically, it examined the parameters such as, teachers' knowledge on foundation (TWF), strategies to teach AT to students (STR), student assessment using technology (SAT), professional and ethical practice of technology (PEP) as well as learning environment and social interaction (LSI).TWF, STR and LSI have a strong and direct impact on SAT. STR has a direct impact on PEP. However, TWF and LSI do not predict PEP. The results indicate a lack/inadequacy in knowledge and skills of Indian teachers to employ AT in inclusive classrooms. This study is the first attempt to quantitatively assess teacher's knowledge and skills for the use of AT in an inclusive-Indian-classrooms.

Keywords Assistive technology · Digital-equity · Inclusive-education · Teacher-training

1 Introduction

As they work towards the universalization and equity of education, educational initiatives in the Indian sector have frequently shown a resemblance with international initiatives. According to the Rights of Persons with Disabilities Act, 2016 (RPWD Act), "inclusion" is defined as "a system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably

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adapted to meet the learning needs of different types of students with disabilities" [1, 2]. The 76th National Sample Survey from 2018 in India showed that disability is a serious issue there because 48% of people with disabilities are illiterate and only 9% of impaired persons between the ages of 3 and 35 have finished higher secondary education, and only 62.9% of disabled people have ever attended regular schools [2].

Disability and exclusion stand out as a significant barrier to the disabled completing their education. Despite the constitutional requirements, a ground-level examination finds that India's efforts to promote inclusiveness are still in their "infancy stage" [3]. Legislative concepts and actuality are far apart [4]. Studies clearly emphasise that in order to implement inclusion, "teacher preparation, the availability of instructional materials, a barrier-free environment, full participation, and support services" are essential [4]. Among these, teacher training is urgently needed [2, 5, 6]. In addition, "support services" like assistive technology (AT) can promote inclusion even more. Assistive goods and services are part of AT. Each person's customized, personal (they travel with them), tailored, and devoted AT devices are meticulously designed, fitted, and modified to suit specific strengths and shortcomings [7]. The use of assistive technology (AT) enhances learning for students with impairments and empowers them [8]. Technology has emerged as a possible intervention for diverse students to pursue education, even though inclusion is an effort to address diversity in education [9].

2   Literature Review

Only one in ten persons who require assistive devices have access to them globally [10]. In their scoping analysis on the availability and usage of AT, funded by the WHO, Hair et al. [11] classified India as a Resource-Limited Environment (RLEs), meaning that the nation has insufficient human, financial, and infrastructural resources to provide rehabilitation. The lack of AT knowledge and expertise among instructors in inclusive classrooms may be a major factor in the failure of AT use and inclusion implementation globally, according to study [8, 12, 13]. Hence, this study assesses the implementation of inclusion and the AT-use in the Indian education.

It is advantageous for a teacher to have knowledge of the characteristics of the student. Primary research in this area suggests that teachers who are aware of their students' individual characteristics foster a psychologically safe environment for all students, assess each student's readiness for learning, identify multiple entry points to the curriculum to boost engagement and success, and cultivate and exhibit higher emotional intelligence in the classroom [14]. On the other hand, instructors who are unable to comprehend the needs of their students may be unable to properly evaluate them [15]. Additionally, an important aspect of inclusive education is the Individualized Education Plan (IEP) (i.e., student-centered learning). Adopting technology for identifying and assessing students with exceptional learning needs may benefit from a teacher's knowledge of the foundation (TWF). For example, by identifying the positioning of devices for optimum learning.

H$_1$: TWF will be positively related to SAT.

The idea of "knowledge on foundations" refers to teachers' perceptions of their knowledge and abilities regarding the theories, terminology, goals, legislative requirements, and governmental/legal demands pertaining to AT. According to researcher Lahm, effective teaching requires a solid understanding of AT from the ground up [16]. This understanding encompassed pertinent ideas, problems, justifications, objectives, and statutory requirements [16]. It is not yet known if TWF can help teachers in understanding ethical, legal, and human issues related to technology use in special education. This needs to be explored using the following hypothesis:

H$_2$: TWF will be positively related to PEP.

The ability of the teacher to comprehend the unique qualities and differences of each learner is one of the strategies used to teach AT to students. For effective inclusion in the classroom, learners' differences or other major qualities must be understood in the context of their "academic and social talents, interactions, attitudes, interests, career options, and beliefs" [16]. In order to develop math proficiency, a teacher might assign two students—one with a disability and the other without—to a Computer-Assisted-Instruction (CAI) programme. The student with the disability may not successfully complete the CAI because of the disability [16]. It is crucial to have a complete grasp of learner characteristics at all stages of development in order to match the educational assignment to the learner's skills and the technology at hand [16]. Hence, the following hypothesis was proposed.

H$_3$: STR will be positively related to SAT.

Teachers may lack the confidence and/or clarity to use AT devices in the classroom due to a lack of of existing training programmes [2] and a lack of familiarity with these crucial abilities [6]. On the other hand, proficient use of AT devices was linked to more AT knowledge [8]. If the teacher is good at strategies to teach AT to students, he needs to be able to to maintain acquire new knowledge and skills in technology to add up to the ongoing professional development. This relation has to be tested.

H$_4$: STR will be positively related to PEP.

The various physical settings, social circumstances, and cultural settings in which students learn are referred to as learning environments. It is not only a standard classroom but also a space for collaboration, a venue for engaging in active dialogue with a teacher or with other students [17]. To increase the students' social acceptance in an inclusive classroom, the teachers' thorough knowledge of employing AT is essential [16]. This entails setting up and running the classrooms with sufficient AT devices, ergonomic principles, anticipating and resolving issues with its incorporation, administration, and security in inclusive classrooms. This can make it easier for teachers to find assistive devices that can help students meet their environmental needs when working with team members.

H$_5$: LSI will be positively related to SAT.

For students with impairments, the provision of precise AT equipment (such as wheelchairs, white canes, and reflective tape) in the learning environment and during social interactions (LSI) is essential [17]. AT includes modern technical products and services since it is distinct, tailored, and focused on all types of disabilities [7]. Lack of these resources or a failure to recognise each student's unique needs might
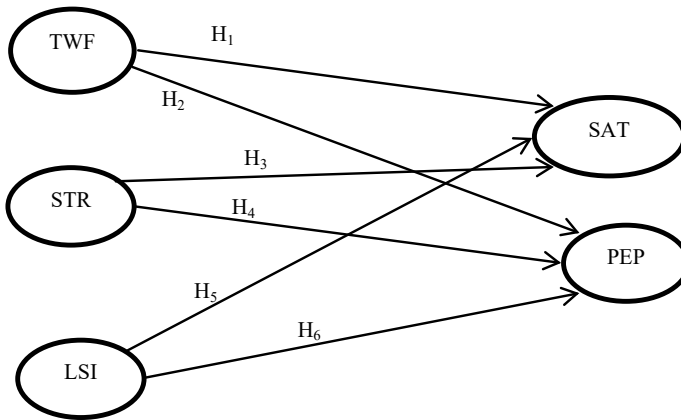
Fig. 1 Conceptual model

negatively affect the usage of assistive technology, which will impede learning [18]. Regarding the reproduction and distribution of software and other content protected by copyright in technology, teachers must be able to abide with the copyright rules. A strong LSI might or might not result in PEP. This is verified through the following hypothesis.

H_6**: LSI will be positively related to PEP** (Fig. 1).

3   Research Methodology

The present study analysed the knowledge and skills of special-educators and general-educators in India. The total surveyed population was 200 male and female teachers. They taught at elementary/middle/senior-schools. Data was collected across various states of India. It helped to obtain high statistical power as well as greater occupational heterogeneity [19]. The sample was drawn using stratified random sampling method. 450 survey questionnaires were distributed to the participants. After rejecting the incomplete questionnaires, 100 (i.e., 22%) fully completed questionnaires were retained for the study. Table 1 shows the characteristics of the sample.

This study specifically examined the teachers' perceived skills and knowledge under each of the following sections: Knowledge on Foundation (TWF) (4 questions), (b) Strategies to teach AT to students (STR) (5 questions), (c) Learning environment and social interactions (LSI) (4 questions), (d) Student assessment using technology (SAT) (10 questions), (e) Professional and ethical practice of technology (5 questions) [20] (UKAT Project, 2002). Further, these constructs were measured though a 5-point-Likert-scale. Here, the lowest value indicates "no expertise" and highest Likert value indicates a "high level of expertise" in that domain.

Table 1 Sample characteristics

Demographics	Classification	Results (%)
Gender	Male	66
	Female	343
Age-group	21–30 years	20.1
	31–40 years	19.1
	41–50 years	42.2
	51–60 years	11.1
Profession	General-educator	31.2
	Special-educator	68.8
Training in AT	Yes	52.8
	No	47.2
Level management	Entry	46.6
	Middle	39.3
	Senior	14.1
Primary disabilities encountered	Learning-disabilities	25.1
	Autism	26.6
	Intellectual-disabilities	14.6
	Visual-impairment	19.6
	Hearing-impairment	14.1

4 Data Analysis

Table 2 shows that the outer loadings of all the items are above 0.50 which are very good and acceptable. The average variance extracted (AVE) are all above 0.50. Composite reliability of all the variables is above 0.60 and VIF values of all the variables is less than 3. Hence all the required criteria are met. Table 3 shows the discriminant validity results among TWF, STR, LSI, PEP and SAT. It is observed that the correlation of any variable with the other variablesis less than the square root of AVE of the variable [21, 22]. This is observed for all variables in Table 3. This satisfies the discriminant validity of the variables.

The path coefficients are greater than 0.1 and the variance explained (R-squared values) of the endogenous constructs are very strong. The R-squared values are greater than 0.24 for SAT and PEP variables (endogenous variables). All the path coefficients are greater than 0.24 and they are significant. So the structural model was validated.

The strength of each path of the structural equation model and the variance (R^2 coefficients) of the endogenous constructs should be greater than 0.1. Figure 2 shows that the R-squared coefficients of endogenous latent variables are greater than 0.24 (good amount of variance is explained by the hypothesised variables). TWF, STR and LSI are exogenous variables, so there exists no R-squared value. As evident in Fig. 2 and Table 4, all the significant path coefficients are above 0.24 except for one

Table 2 Outer loadings of indicators, composite reliability, average variance extracted (AVEs) and variance inflation factor (VIFs) of variables

Variable	Outer loadings	Composite reliability (CR)	Average variance extracted (AVE)	Variance inflation factor (VIF)
TWF		0.84	0.55	1.44
TWF 1	0.50			
TWF 2	0.54			
TWF 3	0.55			
TWF 4	0.53			
STR		**0.85**	**0.52**	**1.50**
STR 1	0.77			
STR 2	0.72			
STR 3	0.70			
STR 4				
STR 5				
SAT		**0.89**	**0.60**	**2.04**
SAT 1	0.67			
SAT 2	0.58			
SAT 3	0.51			
SAT 4	0.57			
SAT 5	0.69			
SAT 6	0.59			
SAT 7	0.70			
SAT 8	0.72			
SAT 9	0.62			
SAT 10	0.68			
LSI		**0.86**	**0.55**	**1.93**
LSI 1	0.55			
LSI 2	0.59			
LSI 3	0.58			
LSI 4	0.62			
PEP		**0.87**	**0.61**	**1.60**
PEP 1	0.55			
PEP 2	0.66			
PEP 3	0.67			
PEP 4	0.71			
PEP 5	0.75			

Note TWF—Teachers' knowledge on foundation; STR—Strategies to teach AT to students; SAT—Student Assessment using technology; LSI—Learning interaction and social interaction; PEP—Professional and ethical practice of technology

Table 3 Discriminant validity results

Variable	TWF	STR	LSI	SAT	PEP
TWF	**(0.74)**	0.48	0.49	0.39	0.45
STR	0.48	**(0.72)**	0.64	0.57	0.44
LSI	0.49	0.64	**(0.74)**	0.53	0.42
SAT	0.39	0.57	0.53	**(0.77)**	0.48
PEP	0.45	0.44	0.42	0.48	**(0.78)**

Note The square root of AVE are shown on the diagonals, all of which are greater than the bivariate correlation between the variables
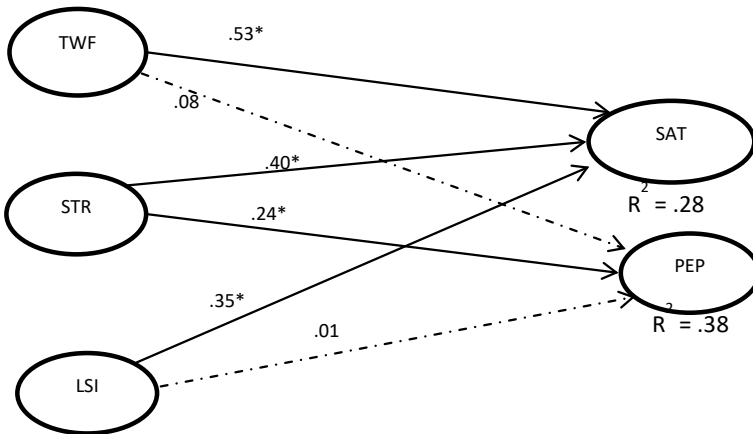
Fig. 2 Structural equation model and estimated parameters. *Note* solid lines indicate significant relation and dotted lines represent insignificant relations; * denotes significant at $p < 0.01$; R^2 represents variance of latent variable; TWF—Teachers' knowledge on foundation; STR—Strategies to teach AT to students; SAT—Student Assessment using technology; LSI—Learning environment and social interaction; PEP—Professional and ethical practice of technology

path which is insignificant. Hence, the structural model is validated. Table 5 shows that all the fit indices of the model are very good.

5 Results and Discussion

The results of the data analysis in Table 5 implicate that teachers' knowledge on foundation, strategies to teach AT to students and Learning environment and social interaction have a direct and significant effect on Student assessment using technology ($\beta = 0.53$, $p < 0.01$; $\beta = 0.40$, $p < 0.01$ and $\beta = 0.35$, $p < 0.01$ respectively). Hence, hypothesesH_1, H_3 and H_5 were accepted. The various skills that are

Table 4 PLS-SEM results

Hypotheses	Paths	Path coefficients	Result
H_1	TWF → SAT	0.53^{**}	Accepted
H_2	TWF → PEP	0.08	Refuted
H_3	STR → SAT	0.40^{*}	Accepted
H_4	STR → PEP	0.24^{*}	Accepted
H_5	LSI → SAT	0.35^{*}	Accepted
H_6	LSI → PEP	0.01	Refuted

Note Path coefficients with * and ** represent significance at 0.05 and 0.01 levels respectively

Table 5 Model fit and quality indices

Index	Model results	Model fit criteria
Average path coefficient (APC)	0.33, $p < 0.001$	$p < 0.001$
Average R-squared (ARS)	0.38, $p < 0.001$	$p < 0.001$
Average adjusted R-squared (AARS)	0.37, $p < 0.001$	$p < 0.001$
Average block variance inflation factor (AVIF)	1.72	≤ 3.3
Sympson's paradox ratio (SPR)	1.00	≥ 0.7, ideally $= 1$
Average full collinearity VIF (AFVIF)	1.77	≤ 3.3
R-Squared contribution ratio (RSCR)	1.00	≥ 0.9, ideally $= 1$
Statistical suppression ratio (SSR)	1.00	≥ 0.7
Nonlinear bivariate causality direction ratio (NLBCDR)	1.00	≥ 0.7

essential for teachers engaging inclusive classrooms include: an empirical knowledge of the legal, and historical principles of special education, classroom teaching, instructional and assessment skills so as to assess and tackle the individual learners, manage diverse behaviour in classrooms and engage in healthy social interaction skills with students. Some others include professional and collaborative engagements with colleagues and practising ethical norms. Teachers with these abilities can recognise functional demands and constraints to determine whether a thorough review of assistive technology is necessary.

Teachers' knowledge on foundation (TWF) and Learning environment and social interaction (LSI) do not have a significant effect on Professional and ethical practice of technology ($\beta = 0.08$, $p > 0.01$ and $\beta = 0.01$, $p > 0.01$ respectively). Thus, hypotheses H_2 and H_6 wererefuted.Copyright laws related to assistive-technology software and its uses may not be related to the teachers' knowledge about using the AT.

Strategies to teach AT to students is found to have a direct and significant impact on Professional and ethical practice of technology ($\beta = 0.24$, $p < 0.01$). Hence, hypothesis H_4 was accepted. Teachers need to employ different instructions for the same topic, learning through activities and pay individual attention for specially abled students in classroom so that they can learn easily.

6 Conclusion

Our research has highlighted the need of teachers' knowledge on using the AT is of high value to include inclusive education in schools so that no student feels left out. They need to be fully aware of the professional and ethical practice of the technologies by updating themselves about the publications, new knowledge and skills about the different assistive technologies that are implemented in their schools.

The presence of AT devices in inclusive classrooms can also improve the teachers' familiarity, expertise, and positive attitude toward its use in in instructional spaces (classrooms) and social interaction. The lack of high-tech/medical AT devices and lack of familiarity with multipurpose disability training may negatively impact STR [2, 17]. The results of this study will assist schools in establishing psychologically secure learning environments for all students, assessing each student's preparedness for learning, addressing diverse instructional strategies to enhance engagement with the curriculum, and engaging in better emotional intelligence for better social interaction.

Education can transform the socio-economic circumstances of people with disabilities; the mental well-being is another advantage too. According to several research, education level has a significant impact on reducing socioeconomic and health inequalities. One key tool for achieving economic independence, upward social mobility, and social status change was education. India has been classified by the WHO as having RLE [11]. The second-largest population in the world is found in this developing nation. Therefore, there may be legitimately important grey areas for implementing customised educational techniques, such as inadequate funding and infrastructure and huge class strength. The current study has made an effort to evaluate teachers' AT knowledge and proficiency. As a result, it has added to the scant body of knowledge regarding the usage of AT tools and services by Indian teachers. This work is distinctive since it has provided insight into a little-explored topic. In this place, it evaluates and draws conclusions regarding the necessity of teachers' understanding of AT, the teaching methods they employ, and the requirement for a learning environment and social interaction between teachers and students. The study encompasses teachers from elementary-school to senior-school. Consequently, this broadens the study's scope. As a result, this study expands our understanding of the state of inclusive education and AT use in India and makes it easier to assess impaired pupils through the use of technology.

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An Approach of Deep Learning Technique for Object Detection

Ranjana Shende and Smita Nirkhi

Abstract The goal of this study is to detect object using Deep learning algorithm. Object recognition is a subset of computer vision tasks that includes tasks like object recognition in digital images. Predicting the class of a single object in a frame is required for image classification. Object detection incorporates these tasks and assigns a classification to one or more objects in an image. The proposed research would concentrate on image feature extraction and classification, followed by training a model with provided data of images with known classifications using deep learning techniques. The model would then be able to predict the classification of new images and detect entities. The Faster R-CNN is a more precise and efficient way of generating region proposal through region proposal network. The network can detect the positions of various items accurately and quickly.

Keywords Deep learning · Object detection · Computer vision · Multiple object detection

1 Introduction

Computer vision technology's main goal is to test a computer's cognitive skills. Its key technological idea is to replace the human brain with a computer and the human eye with a camera, enabling the computer to identify and judge objects using advanced technical means. Computer vision systems, which use computers to provide vision and simulation, are used in a number of fields. One of the main functions of image processing in computer vision is object detection and classification. Feature extraction and machine learning algorithms are commonly used. Various methods seem to be sufficient.

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Object detection is a technique for recognizing and locating things in images using computer vision. Object detection is utilized in a variety of applications, including picture recognition and human behaviour analysis, to give relevant information for semantic image interpretation. Faster Region Proposal Network is created by RCNN is a fully convolution network and create suggestion of various scale and aspect ratio. In order to provide information regarding object detection RPN uses neural network [1].

Region Proposal Network (RPN) consists of convolution neural network and proposed region. RPN is a deep convolution network that predicts object boundaries using anchors. RPN are trained from beginning to create region proposal, employed for detection by Fast R-CNN. RPN and Fast R-CNN trained to share convolutional features [2].

To generate region proposal R-CNN and Fast R-CNN uses selective search algorithm. Region proposal is sent into pre-trained CNN for categorization. To process the image RPN employ same convolution layers as fast RCNN detection network. As a result, when compared to algorithms like Selective Search, the RPN takes less time to generate proposals.

2 Literature Review

Ali Alzaabi [3] Object detection security using machine learning was the focus of a systematic literature review. This involves compiling a large number of research papers on a single topic from different time periods in order to answer a series of research questions. The goal is to provide the reader with an overview of what's hot in this field or topic, as well as what research is required. They focus on object detection and machine learning metrics, showing whether there are any metrics unique to this field of research. The author discusses the various applications of the works discussed, as well as where they have been applied.

For video object detection, the best image-based object detection methods were explicitly suggested. Frame-by-frame processing methods are unsuccessful in this situation because the objects have degenerated appearances such motion blur and asymmetrical posture [4].

With varied degrees of R-CNN modification, author [5] presented a complete overview of deep learning object detection algorithm that handles occlusion and low-resolution images. The topic begins with generic object detection pipelines, which serve as the basis for all subsequent activities. Following that, more addition tasks, such as prominent object detection, face detection are briefly discussed. Lastly, many exciting options for deepening one's comprehension of the object detection environment have been suggested.

Susmita Ray [6] looked into the most common classification, regression, and clustering machine learning algorithms. The author's goal is to demonstrate the advantages and disadvantages of machine learning algorithms from the standpoint of an application so that the reader can choose wisely which learning algorithm to

employ to meet the particular demand. These algorithms' benefits and drawbacks have been examined, along with the effectiveness, learning rate, and other aspects of many algorithms. These algorithms' actual-world applications have also been explained with examples.

3   Problem Statement

Identifying the presence of whole objects within a given image is the goal of object detection in the field of computer vision. Machine learning object detection requires two phases: a training phase and a testing phase [7]. Identifying the presence of items in a given image as well as the category to which each object belongs is referred to as object detection. The main goal of feature extraction in image processing is to extract a large number of features from each image.

- Capture a real time image, to detect and classify entire object present in an image.
- To find all instances of a known class of object in an image such as people, cars.
- Using image recognition and deep learning techniques detect an object.
- To build a model of deep learning (Faster RCNN).
- To do Verification and validation of the proposed Model (Fig. 1).

Fig. 1 Block diagram of proposed work
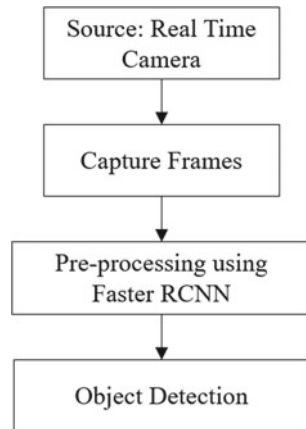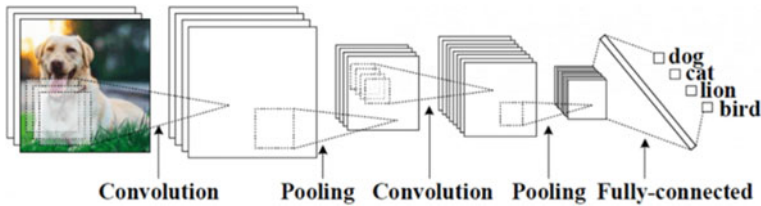
Fig. 2 Convolution network

4   Research Methodology Tools and Techniques

The proposed study includes camera input to capture frames, which are then processed to detect an object after pre-processing. After pre-processing a method for object detection using faster RCNN is employed.

Faster RCNN is divided into three segments.

4.1   Convolution Layers

In the convolution layers, filters are trained to extract the images relevant features. As given in Fig. 2 If we train those filters to extract the necessary attributes for a human face for example, those filters will learn shapes and colors that are unique to the human face.

Convolution networks are made up of three layers: the convolution layer, the pooling layer, and the fully connected layer, which is employed for tasks like classification and detection. As illustrated in Fig. 3, the pooling layer is calculated by sliding a filter along the length of the source image. The resulting matrix is a two-dimensional feature map.

4.2   Region Proposal Network (RPN)

The region proposal network is a multilayer perceptron that moves over the feature map of the convolution layers to predict an object is present in image or not also its bounding box (Fig. 4).

The feature map of the last shared convolution layer is passed via a rectangular sliding window of size n × n. For each window, K region concepts are created. Each proposal is parameterized based on a reference box called an anchor box.

Anchor boxes have 2 parameters:

1   Scale
2   Aspect Ratio.
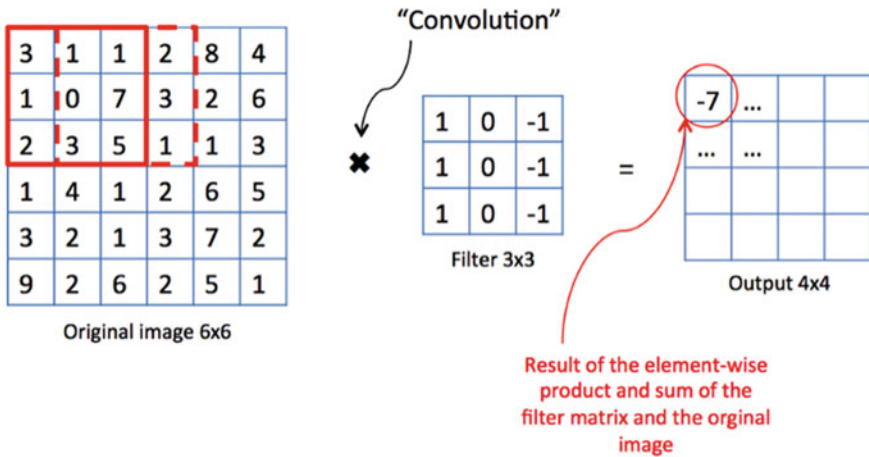
Fig. 3 Convolution filter
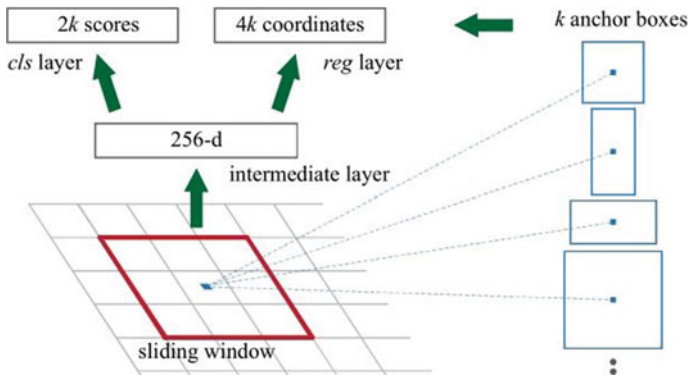
Fig. 4 Region proposal network

4.3 Prediction of Classes and Bounding Boxes

Using the RPN as an input, a fully connected neural network is utilised to predict object class and bounding boxes.

Experimental set up/Design

See Fig. 5.

As given in the above diagram the RPN creates region proposals where object can be possibly found. Different sizes of anchor boxes are used to capture object of every size. Pooling layer of ROI removes a fixed-length feature path from each area proposal in the image. The purpose of ROI is to minimize the entire feature map to the same size. Finally, we have classifier and regression. Classifier used to determine
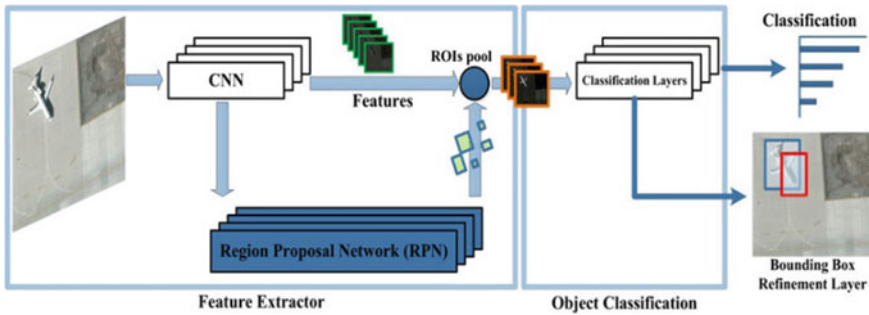
Fig. 5 Working of faster RCNN

if an image contain an object or simply a background. Objective of regression is to create a bounding box for the thing we're categorizing. The bounding box will be refined.

5 Attainment of Research Objectives

Table 1 shows the comparative study of various deep learning techniques with features and approximate time to predict an object.

6 Work Implications

We proposed the system to detect object in real time video and image. We prepared a few experimental setups to test the correctness of proposed technique. The implemented system uses the TensorFlow Object Detection API to train faster RCNN pretrained model on dataset.

Implemented system capture real time image when we run the application output screen detect and classify the object. Multiple objects (like, Person, Scissor, Frisbee) are also detected by the system. Figure 6, shows that the result of object detection with confidence. Person shows 67% confidence, Scissor shows 99% confidence and Frisbee shows 69% confidence.

7 Conclusion

Employed Faster R-CNN technique of deep learning network for object detection successfully detects and classifies objects in images. It uses RPN through convolution layer. For each spatial location we determine whether that bounding box contain an

Table 1 Research objectives

Algorithm/techniques	Features	Time/image prediction	Constraints
CNN	Divides the image into distinct areas, which are subsequently classified into different groups	–	To estimate properly, a large number of areas are required, resulting in a long computation time
R-CNN	To produce regions, it employs selective search. From each image, around 2000 regions are extracted	40–50 s	Due to the fact that each area is transmitted to the CNN independently, there is a significant computation time. It also makes predictions using three different models
Fast R-CNN	Works on CNN. Selective search method is used to create prediction also requires single training stage	2–10 s	As the selective search is slow, high computation time is required
Faster R-CNN	It uses RPN and ROI pooling. It refined the bounding box. Classifier and regression is used	0.2 s	RPN is required to train as all anchors are extracted from single image
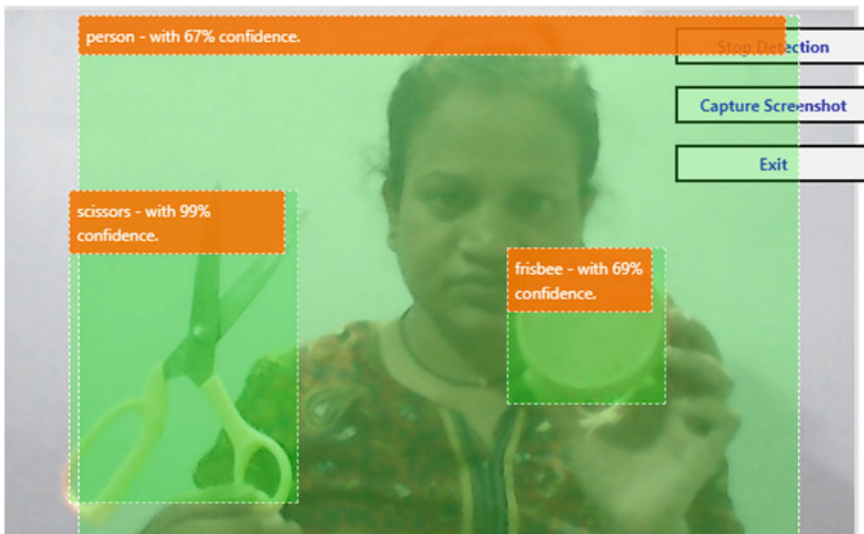
Fig. 6 Object detection using faster RCNN

object or not. From different sizes of region proposal fixed size ROI pooling are used which then classified an object with different categories. It is a faster than fast RCNN as selective search is not required so computation time is high.

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Stock Market Forecasting Using Sentiment Analysis and Deep Learning

Veepin Kumar, Sanjay Singla, Shalika, Sandeep Kang, and Raman Chadha

Abstract Sentimental data processed from digital online communities can be used in different ways for market scrutiny. Sentiment Analysis is a way to extract opinion inclination (negative, neutral, positive) from a fragment of text cited for any institution or product. This word-of-mouth index can in turn be used to speculate the public mood and its market that has an impact on stock prices. Quarrying news articles and predicting the movements of product prices based on the content of Reviews corpus becomes beneficial. This research paper used Sentiment Analysis on the most popular Dow Jones Industries news articles to take advantage of this fact. We then combined this information with market index data from the company during the same time period to create a combined model that offers more accurate results based on Sentiment Analysis and Neural Networks (NN) and will assist the stockholder to lower risk and receive better returns.

Keywords Prediction · Neural network · Sentiment analysis and stock market

1 Introduction

The stock market means the collection of exchanges and markets where well-ordered activities of selling, buying of shares that are publicly held takes place along with their allocation. Stock markets offer a safe and highly structured environment where those who participate in the market negotiate and execute transactions in shares and

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other eligible financial means with credibility with minimal execution menace [1]. The objective of stock market prediction is to determine the movement of stock value in the future of any financial exchange. Its accuracy in prediction can lead to greater profit for the investors. One of the most challenging issues is to predict the stock market trend due to various factors involved such as interest rates, economic growth, and politics that makes the market volatile and extremely hard to predict accurately [2].

In the modern economy, stock market information analysis and forecasting are crucial. Linear (ARIMA and MA) and non-linear models (ARCH and NN) can be used to categorize the many forecasting methods and algorithms [3]. There can be two major divisions of categories as to how the stock market can be predicted, these are namely technical and fundamental analysis. The first category of technical division aims at analyzing historical data of the stock prices for the prediction of future values, whereas the fundamental analysis depends on the examination of a collection of unstructured textual data, such as earning reports and financial news [4]. It is believed that technical analysis can predict the movement of the market but these research did not get high prediction results as they had a huge dependency on structured historical data not considering a very important source of information that consists of social media sentiments and online financial news [5]. Nowadays a large amount of critical information is available on the web related to the stock market including BBC, Yahoo Finance and Bloomberg. It gets hard to manually extract useful information from these sources making text mining for the same significant to extract useful information for analysis [6]. Modern approach to stock market Analysis inculcates both quantitative analyses using historical record of the past behaviour of the organization or product as well as qualitative analysis making use of news feed highly affecting the market trend with the growing influence of social media on prevalent scenarios. Predicting the future of the market comprises a vast range of variables including historic models to psychic models. But as stated by the behavioural economic hypothesis, market stats are related to public mood [3]. Social networking websites can provide a sizable collection of user generated content that in turn can be used for sample aggregation of public opinion for predicting market behaviour. Simple statistical forecasting using historical data based on a company's past performance ignores the importance of customer opinion (social media, news etc.).

In this paper we perform mood detection using lexicon-based sentiment analysis of the scrapped top news articles of the Dow Jones Industries and incorporate that intensity in a NN model that uses historical data to couple qualitative as well as quantitative analysis for our prediction of the stock market opening price for the next two months [7]. The forthcoming sections of this paper include the background of stock market and deep learning in Sect. 2, Sect. 3 explains the formulation of the problem and the suggested methodology. Section 4 describe the result analysis of our proposed solution and its effectiveness and at last, Sect. 5 concludes the research work and provide future directions.

2 Background

The study and analysis of literature is very essential since different researchers have utilised various datasets and approaches to forecast the stock movement trend through sentiment analysis. Huang et al. [1] test the Support Vector Machine's (SVM) capacity to predict the direction of financial movement by predicting the weekly movement direction of the NIKKEI 225 index and compare SVM's performance to that of linear discriminant analysis, quadratic discriminant analysis, and Elman backpropagation NNs in order to assess its predicting ability. The test outcomes show that SVM outperforms the other categorization methods. Khaidem et al. [2] made trials with a framework which anticipate whether stock prices will rise or fall with respect to the price prevailing in the past. Random forest algorithms and gradient boosted decision trees were used to produce results achieving an accuracy of 64%. In order to predict the closing price of an organisation based on previous prices, Hiransha et al. [3] used a number of deep learning models, including Recurrent Neural Networks (RNN), Multilayer Perceptron (MLP), Convolutional Neural Network (CNN), and Long Short-Term Memory (LSTM). CNN outperformed out of all the methods applied in this paper. The results were compared to the linear Autoregressive Integrated Moving Average (ARIMA) model, and it was shown that the NNs performed better than ARIMA. Pathak et al. [4] effectively performs a merge of quantitative as well as qualitative analysis of Indian stock market trends using sentiment analysis and machine learning (ML) with a fuzzy logic module. Sun et al. [6] look into the possibility of forecasting the stock market using text from user-generated microblogs. The model employed in the author's study differs from models used in past studies in two key ways: (1) it employs market information obtained in high-volume social media data rather than news stories, and (2) it does not analyse sentiment. The bulk of the companies listed in the S&P 500 index's data from 2011 to 2015 were used to evaluate the model, and it outperformed a baseline regression.

Usmani and Adil [8] instinctive design combines sentiment analysis results from historical data, news feeds, and twitter feeds. With remarkable accuracy, this strategy forecasts the direction of the stock market. To determine the direction of the market, it employs statistical time series models like ARIMA and SMA. In order to predict stock market trends, Yoo et al. [9] investigated ML models and event responsive algorithms like sentiment analysis. It also emphasises how factors like global and political events have an impact on market development and should be properly consideration. By analysing the text content of daily Twitter feeds using Opinion Finder, Bollen et al. [10] investigated the Dow Jones Industrial Average (DJIA) trend using emotional states from Twitter feeds. In order to investigate the prediction of changes in DJIA closing values by proposition of the public mood conditions measured by the Opinion Finder, a self-organizing fuzzy neural network is used. This network has an accuracy of 77.6 percent in predicting the daily up and down changes in the DJIA closing values. Table 1 list some of the research papers along with the technology used.

According to Porshnev et al. [13], the inclusion of twitter sentiment analysis does not improve the prediction model's accuracy and does not provide any useful

Table 1 Literature survey of different methods used for the problem

No	Author	Year	Technology used
1	Adebiyi et al. [11]	2009	MLP
2	Bollen and Mao [10]	2011	Opinion Finder + Fuzzy NN
3	Smailović et al. [12]	2013	SVM
4	Porshnev et al. [13]	2013	SVM + Neural Networks
5	Kumar and Anand [14]	2014	ARIMA
6	Arias et al. [15]	2014	SVMs and Neural Networks
7	Usmani and Adil [16]	2016	ARIMA and SMA
8	Pagolu et al. [17]	2017	ML
9	Lin et al. [18]	2017	SARIMAX + MLP

information. As a result, this study uses news feeds rather than tweets to increase the validity of sentiment analysis. The study provides a lot of insight into how sentiment analysis should be used. They suggested expanding the collection (training data) when each test was conducted, making the training data more effective as tests were conducted more frequently. Lin et al. [18] use the MLP model taking the sentiment feature alone with last four quarters historical sales number as our input feature.

3 Problem Formulation and Research Methodology

Our problem focuses on improving the application of a combination of quantitative as well as qualitative analysis for market trend determination and prediction. Earlier, there have been applications where this approach has been followed with different methodology and techniques to determine the results, for instance using time series analysis using SARIMAX model or by using MLP technique. We will predict the upcoming opening prices of the Dow Jones industries for a couple of months while considering sentiment indexes calculated using sentiment Analysis in our time series model using an efficient technique different from what has been already applied in the field to produce greater accuracy and reduced root mean square error. The overall architecture of the suggested problem is depicted in Fig. 1.

In this research work, two datasets have been used for the application of final methodology. The first dataset consists of the top twenty-five news articles of the Dow Jones stock prices for each day for a span of 8 whole years. The other dataset consists of stock market data of Dow Jones Industries with attributes including opening price, closing price, high and low prices, adjusted close price and volume for each day over a span of eight years. The news articles data was cleaned by removing unnecessary symbols (@, #, $), spaces, tags and URLs and were further processed to be analysed for opinion mining using NLP techniques. We applied an approach to map the lexical

News Articles

Sentiment Analyzer

Sentiment features

Historical sales data

Sales Predictor

Predicated Sales
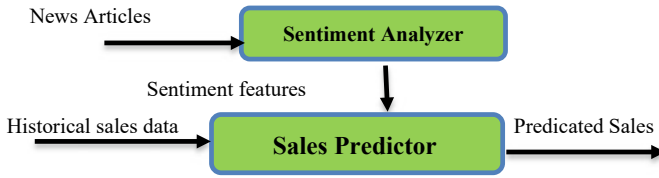
Fig. 1 Overall architecture of the problem

features to sentiment scores within a specific range constituting the range from a negative to a positive polarity of opinion. The key advantage of the lexical method is that since we already have everything, we don't need to train a model on labelled data; instead, all that would be left to do is evaluate the sentiment of sentences in the dictionary of emotions. The procedure for using lexical sentiment analysis is shown in Fig. 2. After processing both the datasets we merged the sentiment indexes and stock market data using matching dates. At the end of the pre-processing phase, the data frame contains attributes containing both stock price attributes and sentiment indexes for news articles computed for each matching day in the dataset. LSTM are well suited to classify, analyze, and predict time series with unpredictable time lags. Due to its relative gap length insensitivity, LSTM has an advantage over RNN, hidden Markov models, and other sequence learning techniques. Furthermore, LSTMs give us a variety of parameter choices, such as learning rates, input and output biases, and more. Consequently, there is no need for minor modifications. With LSTMs, updating each weight is now only O (1) in complexity.

A neural network stops learning due to the vanishing gradient problem because of which the updates to the various weights become smaller and smaller within a given neural network. This issue is mitigated with LSTM which makes it ideal for the purpose of predicting stock opening prices for forthcoming days using the stock values of previous records over a period. Problems with multiple input variables

Fig. 2 Working of lexical sentiment analysis

Review text

Split into

Sentences

Stemming and Cleaning

Bag of Words

Compare with

Opinion Lexicon

Scoring function

Sentiment Score
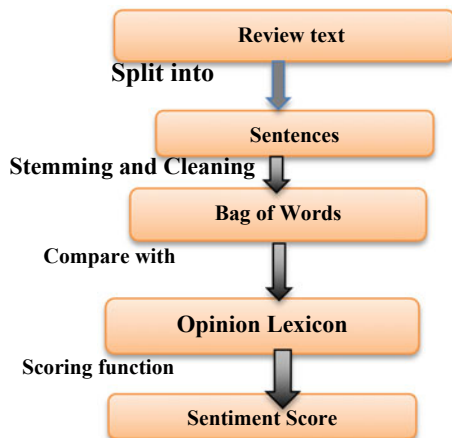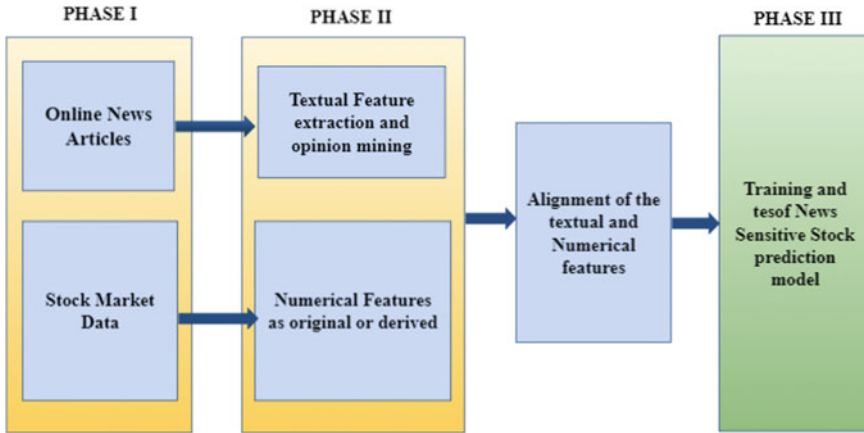
Fig. 3 Overall architecture of solution

can be coherently modelled using recurrent Neural Networks like LSTM. Traditional Linear methods can be hard to use with multiple input forecasting problems. Therefore, it can be a great benefit in time series forecasting. We use a multivariate LSTM Model and train it over different attributes governing Stock market movement to predict the faith of the market with its movement for the next two months. The solution of proposed problem is represented in Fig. 3.

4   Result Analysis

Following results were obtained after performing sentiment analysis on the collection of news articles from the dataset, categorizing them into positive, neutral, and negative as shown in Fig. 4.

The process of forecasting includes making future predictions based on recent and historical data. Networks are essential to assess patterns over time to comprehend the patterns in a long sequence of data. Recurrent networks, such as LSTM, which are used to learn such data, were employed. They can comprehend long-term interconnections and temporal differences. For our research, we trained the model on LSTM units over the span of 30 iterations using the Adam optimizer and Mean Squared Loss function.

Various algorithms have been used to implement a similar structure for stock forecasting and it was observed that the LSTM model provides a much lesser root mean square error than the other methods applied for the same. Figure 5 shows the prediction of a simple time series ARIMA model applied on the historical data of the stocks of Dow Jones Industries. The forecasted value has a large amount of root mean square error upon application rather than a closed curve with much lesser root mean square that is observed while applying the model proposed in Fig. 6.
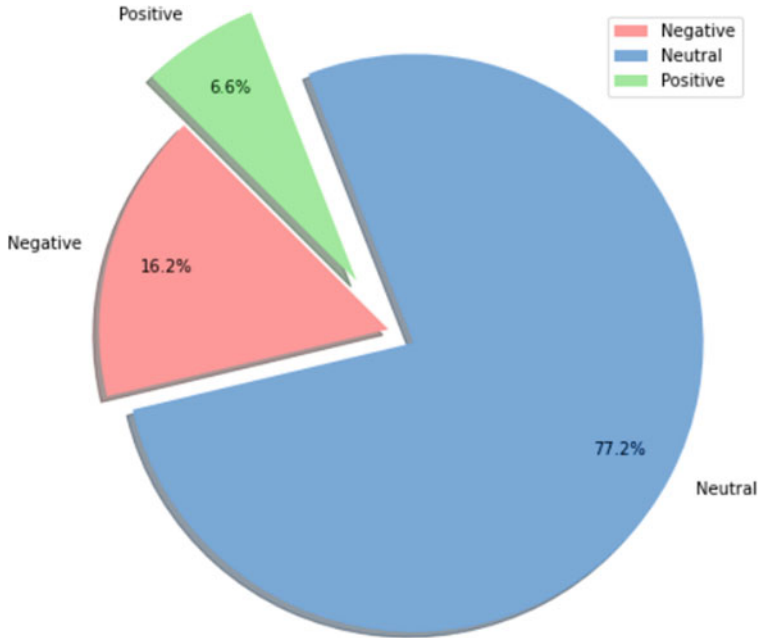
Fig. 4 Sentiment analysis of Dow Jones news headlines

Fig. 5 Training predictions versus actual stock prices with predicted stock price

5 Conclusion and Future Scope

Micro Blogging has become highly popular in today's era because it offers characteristic features like accessibility and satisfaction which allows instant dispersion of information and negligible response time with limited or no restrictions at all on content and security. Before the foundation of behavioural finance was established, research on stock market prediction was entirely based on unpredictable walks along
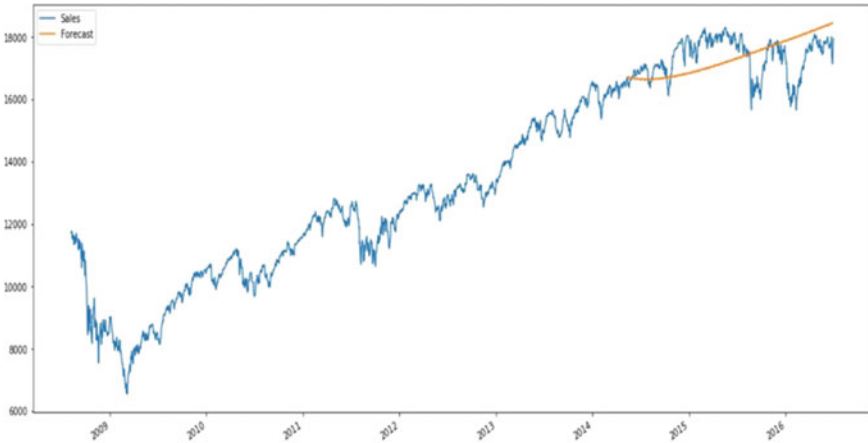
Fig. 6 Graph plot of predictions using ARIMA model

with numerical or quantitative prediction, but with its advent, people's beliefs that mood and emotions were also taken into account when predicting stock market movement. Therefore, we employed the concept of sentiment analysis of News Articles with Deep learning models to make it more effective. The results indicates that there is significant correlation linking the prevailing public emotions and etiquette of investment in the short term nevertheless this correlation is not proved to be significant statistically. Evidence also shows cause and effect relation between prevailing public sentiment and the stock market trends with respect to relationship between public emotions and daily closing prices. As part of a future implementation, we can perform comparative analysis with extreme learning classifiers which do not need gradient based backpropagation to function and deep learning classifiers using attribute pruning on the basis of variables that may be used for forecasting of market.

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Twitter Sentiment Analysis on Russia Ukraine War

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Abstract Twitter is a social networking and microblogging website with approximately 200 million registered users, of which 100 million are active, million people are active on Twitter. Every day, about 250 million tweets are twitted. The recent Russia- Ukraine dispute drew widespread worldwide attention, and a crisis puts an emergency to the test. With the growth of technology, the usage of social media to exchange information and ideas has increased dramatically. In this research, we use real-time data from Twitter to analyses public sentiment on the Ukraine and Russia crises on a global scale. We want to get a reflection of public sentiment by analyzing the sentiments conveyed in tweets due to the widespread use of Twitter. It is critical to assess public opinion.

Keywords Tweets · Sentiments · Social media · Deep learning · Twitter · Analysis · Depression

1 Introduction

Over the last few decades, the use of internet resources, particularly social media and microblogging services like Twitter, has increased at an exponential rate. These resources provide businesses with access to a wealth of marketing information. The goal of this project is to build a classifier that extracts sentiment from tweets using

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machine learning methods. The study's main objective was to compare the performance of several machine learning algorithms. This method also allows for grading tweets according to their intended feelings, which can be classified as negative, neutral, or positive. The proposed machine learning algorithms for sentiment analysis are effective and practical methodologies, according to the results of this study's evaluation.

We opted to partner with Twitter because we believe it provides a better representation of public mood than traditional online articles and web blogs. The reason for this is because Twitter has a considerably higher amount of relevant data than traditional blogging sites. Public sentiment analysis is crucial in macro-scale socioeconomic phenomena such as anticipating a company's stock market rate.

This research, which analyses tweet sentiments, falls under the categories of "Pattern Classification" and "Data Mining." Both of these words are intimately related and entangled, and they can be technically described as the process of automatically (unsupervised) or semi-automatically uncovering "useful" patterns in big sets of data (supervised). The proposed work makes use of natural language processing technique for extraction of significant patterns and features from large dataset of twitter. Machine learning technique is used for classifying unlabelled data samples (tweets) of individual accurately as per the pattern model that describe them the most. There are two types of features that can be used to represent patterns and classification: formal language-based features and informal blogging-based features. Language-based characteristics. The goal of this study is to examine and comprehend public opinion on the Russian-Ukrainian war. The primary goal of this study is to learn more about public opinion on the situation. We'll go through some of the prior work on sentiment analysis using Twitter data in the next part. Understanding and analysing mass sentiment is critical, because there are lot of words that have different meaning (diplomatic meanings) that makes the complete analysing process more difficult to complete, Sentiment analysis is an NLP technique for determining whether data is favourable, negative, or neutral this helps the user, customer or the public to know about the sentiments of the public about any product, service, brand, tweet etc. So that before making any decision we get options and sentiments of the respective options.

2   Literature Review

Depression among any person can be noticed by using parameters like gender, age, financial, and the status of education etc. and thus can help in providing information necessary for manifestations changes in the sentiments.

Mendoza et al. [1] analyze the symptoms of school children from 8 to 11 years to study the depression with factors like age, grade and gender etc. and state that attention and investigation are two factors that are needed for changing the sentiments of children in order to bring them out of depression.

Choudhary et al. [2] identifies the depression by collect data from twitter through two types of techniques. They extract the sentiments from posts of social media from persons by using probabilistic model developed by them. They use depression index parameters of social media in order to characterizes the level of depression.

Coppersmith et al. [3] analyzes the sentiments on post-traumatic stress disorder (PTSD). They perform their test on twitter data and by using proposed method obtain the PTSD classifier for twitter data. In order to extract the result, they difference in use of language between PTSD is analyzed.

Veientlena and Prabhu [4] study about the hypertension in rural areas. In order to perform the study, the data is collected by means of door-to-door collection by means of village survey. The potential hazard factor of hypertension is calculated by using binary logistic regression model. While formulating the result, it was found that family history, level of education and occupation are important factors which contribute for predicting the risk factor of hypertension.

Verma et al. [5] in their book discusses about different aspects of COVID pandemic in agriculture, stock market etc. by using various computational techniques. Most of the data is fetched from twitter or online status available.

Reece et al. [6] uses computational model on twitter data set for studying the depression in post-traumatic stress disorder and in this learning, they make use of supervised learning algorithms and model used for separating the positive sentiment from negative sentiments. For early detection of melancholy, an information-based prediction method is used in their research.

Haselmayer and Jenny [7] uses crowd coding for collecting sentiments for building dictionary for negative sentiments in language and domain of choice. They compare the dictionary-based result with manual coding-based result to prove that crowd-based dictionary proves to be better than coding-based approach.

Dumka et al. [8] uses study about depression status of various persons during lockdown by using Long Short-Term Memory (LSTM) network model and Convolutional Neural Network (CNN) using Keras python deep-learning library. The result proposed was 88.14% accurate with most tweets showed neutral polarity.

Verma et al. [9] study and analyse the impact of COVID-19 on stock index and global economy. They collect online data for their prediction and uses regression model to forecast their results.

3 Method and Methodology Used

3.1 Data Collection Process

Twitter which is one of the most used social networking platforms provides a rich form of information to study about sentiments of the people and their opinions as people used to express their sentiments through tweets. Each tweet can be used

Table 1 Keywords tweets data from 12 to 30 November

#Keywords	
Criminalizes	
War	
Crisis	
Casuality	
Death	
Inflation	
Migration	
Data pre-processing statistics	
Statistic label calculated	Name
Tweets from 12 to 30 Nov. 2021	10 M
Tweets of alternative days from 12 to 30 November 2021	6 M
Tweets done in English language from 12 to 30 November 2021	7 M
Tweets done in alternative days from 12 to 30 November 2021	3 M
Tweets from verified user account	621,225
Research consideration statistics	
Tweets of alternative days performed from verified user account	314,156
Tweets from training set	223,452 (75%) approx.
Tweets from test set	76,574 (25%) approx.

for determining the sentiments of any individual which can be classified as positive, negative and neutral emotion. The dataset collected from twitter with hashtag keywords is presented in Table 1.

The data shows above shows the tweets captured in languages like English, French, Spanish, and German, etc. from November 12–30, 2020. For this research, English language tweets posted on 10 alternative days are considered.

3.2 Data Pre-processing

For data pre-processing, the data passes through file conversion, data normalization tokenization, data cleaning, stop word removal, morphological normalization and polarity calculation. File conversion changed the data into parsed data which will be saved as a comma-separated document (*csv*) for a simple examination and analysis of the data. Data normalization helps to transfer text information into valuable standard design for easy execution. Data normalization is performed by tokenization where tokens are created from text. Followed by data cleaning where unused items are

cleaned or removed from the data set. This is followed by stop word removal where words that occur commonly across all the documents in the corpus are removed. Followed by morphological normalization can be achieved through two techniques as stemming and lemmatization. This is used to built up words for small meaning bearing units termed as morphemes. Followed by polarity calculation which arrange the words based on their polarity as positive, negative and neutral sentiments.

In order to arrive at the best outcome, we use data mining approaches and apply the following Machine Learning algorithm for the second classification.

3.3 Naive Bayes

Naïve bayes classification helps in text categorization which classify the entire text by means of text categorization label selected from collection of labels. Since Naive bayes classification is the simplest and fastest classification method and hence used to classify the products in order to get the best results. It helps in determining the label for specific tweet by calculating the probabilities of all labels and then help in choosing the labels with highest likelihood.

3.4 Natural Language Processing

Natural language processing (NLP) which is subset of artificial intelligence helps to analyze, comprehend and infer meaning from human language. NLP is used to organize and arrange knowledge for task like automatic summarization, translation, named entity recognition, extraction of relationship, topic segmentation, speech recognition, sentiment analysis etc. Thus, it helps in addressing the hierarchical structure of language and analyze the text such that machine can interpret the human speech.

4 System Architecture

The framework proposed for analysis of sentiments help in classifying the sentiments and their corresponding subjectivity. As Fig. 1 shows that Sentiment analysis process has various phases, that include collection of data, preprocessing it, feature extraction followed by sentiment identification, classification and then finally output presentation. This system architecture can properly explain the complete flow of our project (we are getting complete view of our project from this figure). We have fetched data from twitter in Realtime using the twitter API. After fetching data, we do various operations on the tweets that were fetched by the twitter API. Identifying sentiment is one of the most important aspects of the twitter sentiment analysis.
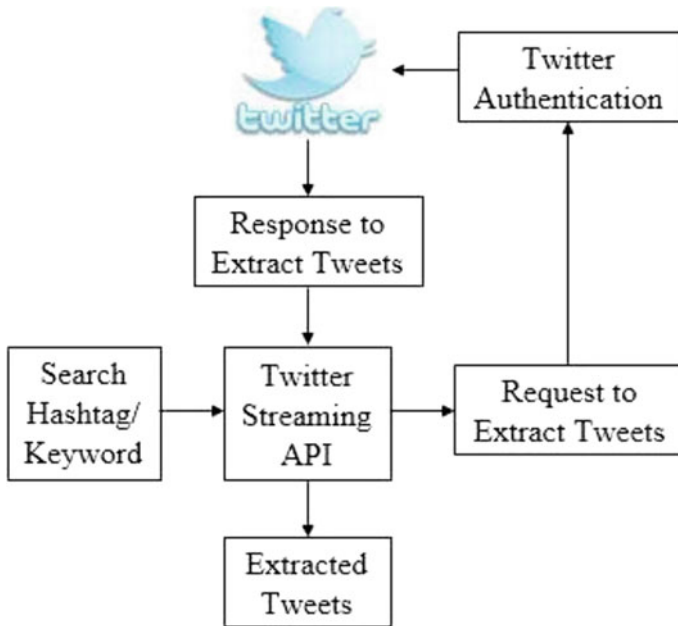
Fig. 1 Data collection process

So, after retrieving real-time data, we determined the sentiment of the tweets, determining whether they are favorable, negative, or neutral, so that we can access those tweets and their feelings through the web app we constructed with Flask, which is the actual desired consequence of this project. We retrieved data from Twitter in Realtime using the Twitter API, and then performed various operations on the tweets that were on Realtime (Fig. 2).

Figure shows how tweets are collected from Twitter (via Twitter API), data preprocessing, feature extraction, sentiment identification, and classification, and finally output presentation, which we have done through that web app where we have given the feature to search a keyword according to your needs, and you will get the sentiment and data in real-time.

This system architecture helps us to understand the complete functioning properly of our project, what we have done, what we were trying to do, and how this project is going to work, so this system architecture was to get the better view of the project.

Twitter is so popular nowadays; we chose it for our data collecting. In February 2020, Twitter will have over 300 million accounts. Twitter is a great place to learn about people's thoughts and analyses sentiment. Each tweet is significant in determining if an individual's opinion is good, negative, or neutral. The most difficult aspect of utilizing Twitter is that each post has its own 140-character limit, which means that tweets can be found using hashtags or keywords. Hashtags, also known as keywords, are used to group tweets together and make them simpler to discover. The Twitter API is required to retrieve tweets from users who utilize phrases and
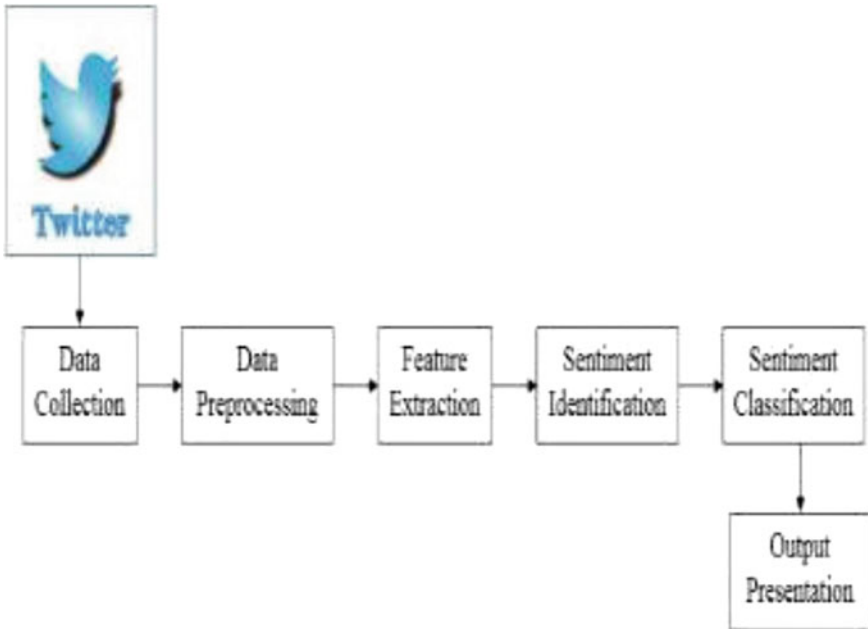
Fig. 2 System architecture of the process

short words that do not fit into the standard language processing method. Twitter has expanded the word limit for each tweet to 280 characters, which would be extremely useful in assessing a message's emotion and establishing its polarity.

One of Twitter's limitations is that the Twitter Search API can only produce a certain number of tweets at a time. The Tweepy Python package can be used to access the Twitter API. Tweepy makes it simple to leverage Twitter's streaming API. It is responsible for authentication, connection, and a variety of additional functions. Accessing Twitter streams requires API authentication. Twitter messages are downloaded in real time using the Twitter streaming API. It can be used to get a large number of tweets or to create a live feed utilizing a site stream or a user stream. This Twitter streaming API can be used to retrieve tweets for any hashtag or term that has been tweeted. So that we can know sentiments of the public about any particular keyword Data collection process here is done in real time basis instead of manually taking each tweet from the twitter or taking a dataset and then working on it, accessing real time tweet is done with the help of twitter API (Fig. 3; Table 2).

The accuracy (Acc.), Precision value, Recall value and F-score is calculated by applying the formulas;

$$recall = \frac{True\ positive}{True\ positive + False\ positive} \tag{1}$$
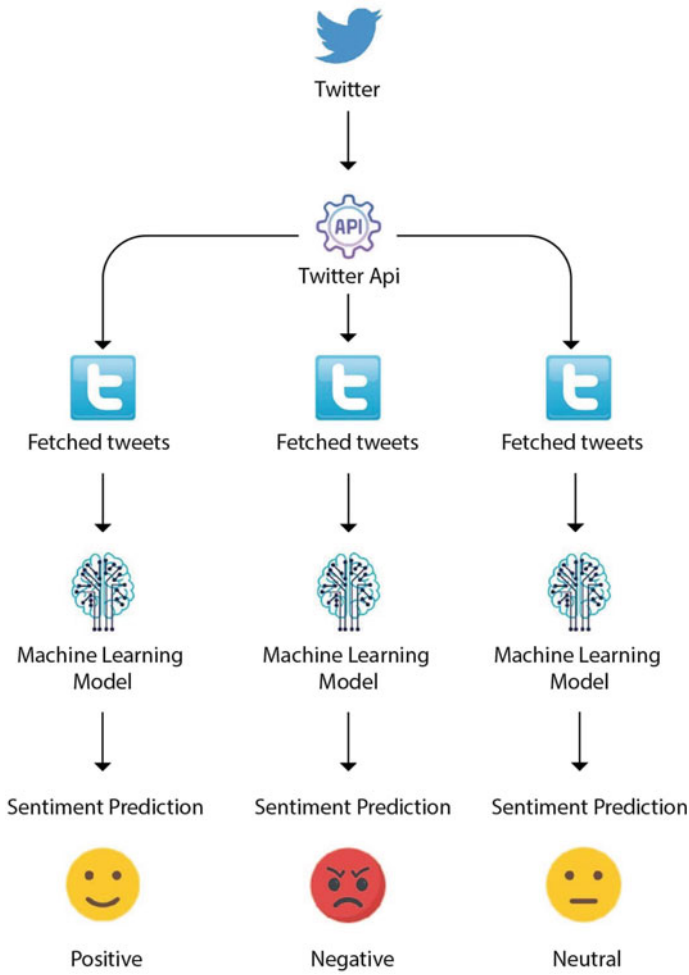
Fig. 3 Sentiment analysis flow Process

Table 2 Matrix showing the positive, negative and neutral opinion of tweets of users

Predicted value	Actual values		
	Positive	Negative	Neutral
Positive	45,190	4214	5242
Negative	3365	60,887	3757
Neutral	3594	7020	97,632
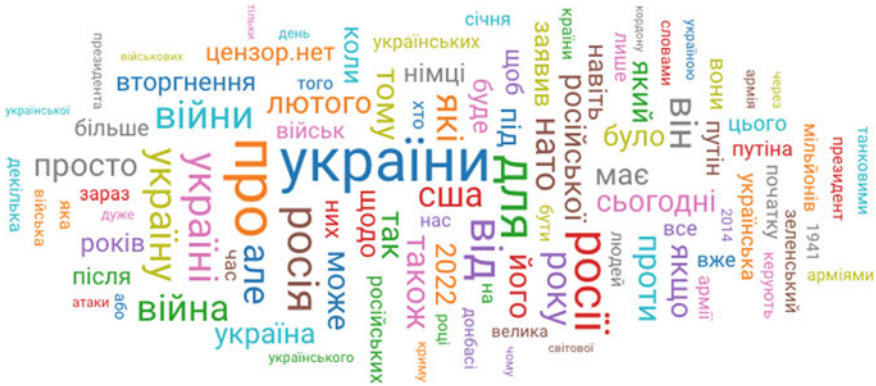
Fig. 4 Word cloud for twitter data analysis on Russia-Ukraine War

Table 3 Performance metrics of CNN_LSTM model

	Precision	Recall	F1-score	Accuracy
Positive	0.83	0.87	0.85	92.82
Negative	0.89	0.84	0.87	92
Neutral	0.90	0.91	0.91	91.46

$$precision = \frac{True\ positive}{True\ positive\ +\ False\ negative} \tag{2}$$

$$f1 - score = 2 \times \frac{(precision \times recall)}{(precision + recall)} \tag{3}$$

$$Accuracy = \frac{(True\ positive + True\ negative)}{(True\ positive + True\ negative) + (false\ positive + false\ negative)} \tag{4}$$

Applying formulas form Eqs. (1, 2, 3 and 4) to evaluate the classification report of mental health analysis as follows (Fig. 4; Table 3).

5 Conclusion

We used the naive bayes classification method to get real-time data from Twitter using the Twitter API; this data (real-time tweets) is dynamic rather than static. We designed a web app for better user engagement. With our web app, a user may access tweets by simply entering the word or emotion and the number of tweets he/she wants to read and get the sentiment of each. We have divided it into two sections: phrase level sentiment analysis and sentence level sentiment analysis. In phrase level sentiment analysis, you must first enter the keyword and then count (the number

of tweets you want to get) to get the results, which will include the feelings of the specific tweet as well as the entire tweet (these twitter data will be realtime).

It will just give you the polarity of the tweet in the sentiment level; you can enter any text and it will show the polarity of that statement. The goal of this project is to dynamically analyse Twitter sentiments in real time, to eliminate all of the manual labour that we currently do, and to provide an interface that allows users to interact quickly (web app). This will save a lot of time and effort. When it comes to any business-related job, Twitter sentiment analysis plays a vital role in understanding public opinion about any issue or topic. It also assists companies by letting them know how the public feels about their service, product, or brand, among other things. This real-time Twitter sentiment analysis of the Ukraine-Russia war will assist people understand what the world's perspectives are on the conflict, which may help them see the wider picture with a clearer perspective.

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Social Distancing Detector Using YOLO3 Algorithm

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Abstract In 2019 our world was introduced by a pandemic named as corona which had taken a lot of lives, because of which our India has suffered a lot. So we decided to make something which can help peoples to follow the norms of government and can take care of others as well as themselves. Hence we had decided to work on this project. The social distancing among persons are the best solution for avoiding the COVID and thus this paper is based on similar aspects. The paper proposes a solution for maintaining the distance among person as per guidelines by using YOLO based algorithm and proposed a solution as "Social Distancing Detector". Social distance detector is used to provide information about people who disobey the norms of maintaining the distance between any two persons and provide demarcation by means of red rectangular box for those who are not maintaining the proper distance among themselves whereas segregating other with green rectangle boxes. Thus, social distancing can be monitored through remote location and having clear demarcation.

Keywords YOLOv3 · COVID · Social distance · Object detection

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1   Introduction

As we all know during this pandemic of covid-19 it is necessary and important as per the norms of government that everyone should maintain social distancing for their safety as well as for others too. With wearing mask it is also important to maintain social distancing. With the emergence of new coronavirus (COVID-19) pandemic, the people become anxious with spread of virus and no effective treatment of the pandemic.

Public health organizations like the Centers for Disease Control and Prevention (CDC) needed to clarify this preventing close contact with others is the most effective way to slow the spread of COVID-19. The world yet is not recovered with is pandemic. The chances of infection and its spreading can be reduced by avoiding person-to person contact and by maintaining social distancing of at least 50 pixel. The social distance is necessary as the virus of COVID pandemic spread when any infected person comes in close contact with another non-infectious person.

During COVID-19, the term social distancing spread and which only helps during initial phase of pandemic to minimize or interrupt the transmission of virus of COVID-19.It aims at reducing the physical contact between possibly infected individuals and healthy persons. Measures taken to implement social distancing are, increase physical space between workers in the workplace, scale up working hours, reduce social contact in the workplace, non-essential travel has been limit, and conducting regular personnel health checks. Indeed, it has been observed that many people are unaware of public health measures, particularly when it comes to social distancing.

Social distancing helps us not to protect from COVID-19 only but also from all those diseases which may be transmitted by human contacts. With invent of technology especially in the field of computer science managing the social distancing and finding violation of social distancing is challenging. The technique like image processing, Machine learning, Artificial learning etc. helps a lot in finding violation of social distancing. There are multiple approaches proposed by different researchers to find violation of social distancing through different techniques.

The proposed paper provide solution to the issue of COVID and provide remote based social distancing detector by using image proposing. The proposed approach uses YOLO algorithm to achieve the desired results. The proposed approach can be used to find violation of social distancing in MALL or public places and can also be used for other purpose where maintenance of social distancing required.

2   Literature Review

Nepal and Eslamiat [1] compare YOLO algorithm different version for emergency landing spot detection for unmanned aerial vehicles using DOTA dataset. In their research they compare YOLO Version-3, Version-4 and Version-5 to conclude their research. Their comparison was based on the parameters of accuracy and speed. In

their result, it was found that in terms of speed, YOLO version-3 is better than YOLO version-4 and version-5. Whereas YOLO version 4 and version 5 are better in terms of accuracy than YOLO version-3.

Redmon and Farhadi [2] and Viraktamath et al. [3] explain the architecture of YOLOv3, which consists of three parts as base network or backbone which is also termed as darknet-53, neck and head. Backbone is used to extracting the features whereas neck is used for collection of features extracted by backbone whereas head draw the bounding boxes and classification.

Huang et al. [4] discusses about YOLO-LITE which is a lighter version of YOLO used for running of CPU. Researchers Bochkovskiy et al. [5] discusses about YOLOv4 and Wang et al. [6] discusses about scaled YOLOv4. Bochkovskiy discuss about contribution of YOLOv4 in terms of speed and accuracy for object detection whereas Yao about advantages of scaled YOLOv4 on different parameters.

Zhao et al. [7] in their paper compare the deep learning-based object detection algorithms and find that YOLO algorithm provides to be better than algorithms like Fast R-CNN, Faster R-CNN. Rajput et al. [8] have used Yolov3 algorithm for training of data on vehicle of different classes which is used to identify and classify the data which can be used for toll management at toll plaza.

Aishwarya et al. [9] proposed YOLO and tiny YOLO based architecture for Intelligent Driver Assistant System for detection of vehicle and pedestrian for efficient traffic management system. Song et al. [10] proposed vision-based vehicle detection by extracting surface of road using Gaussian mixture model of image segmentation process and then apply YOLOv3 algorithm for detection of vehicle.

Martinez-Alpiste et al. [11] proposed an improved version of YOLOv3 in order to increase the speed of YOLOv3 by maintaining the accuracy. Yin et al. [12] detect object of 3D images using YOLOv3 and K-mean algorithm. These images were captured through LIDAR camera in autonomous driving system.

3 Method and Methodology Used

The proposed system makes use of computer vision and deep learning in order to identify any objects (person) in image or video stream to maintain the social distancing. OpenCV is used in this work for image-processing operations.

In order to achieve the required results, the detection of human in the frame is done using YOLOv3. In order to achieve the proposed output, the proposed approach is divided into 4 parts as:

1. Bird Eye View and Error Detection
2. Object Detection
3. Announcement and Error Detection

Bird Eye View Bird's-eye view as name suggest is view from bird's eye that is it is the elevated view of an object from camera mounted above as camera here act as a bird with the image captured by camera as bird's view which is used for making
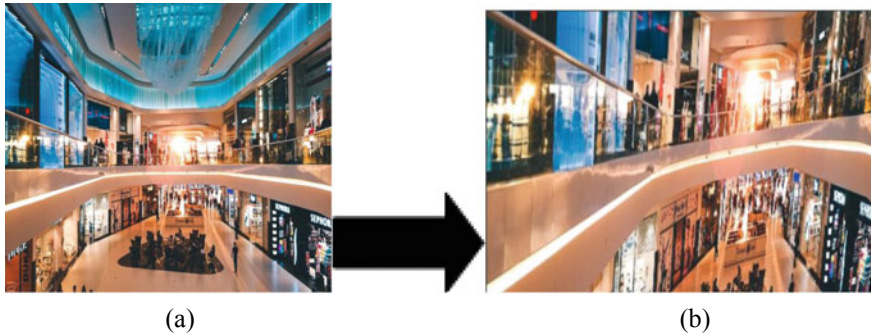
Fig. 1 Shows the normal view **(a)** and bird eye view **(b)**

blueprint, maps, plan of floor etc. and same can be linked to aerial photography. Hence, the bird eye view is used for observing a location with respect to perspective of bird (Fig. 1).

Object Detection The object is detected using YOLOv3 algorithm and using python the coding for object detection was done. The algorithm is designed such that the object detection should align within the green rectangular box. The proposed algorithm detects only people class and accurately detect the person as object.

Announcement and Error Detection For announcement part is based on text to speech which is an assistive technology that converts text to speech and read that speech loudly. Thus, announcement system will help in making alert as announcement if anyone violating the social distance norms whereas error detection the programming is done such that the code evaluates the centroids and the threshold value assign make sure that any 2-person lying below the assign threshold value the red rectangular box should appear whereas any person lies above the assign threshold value then green rectangular box should appear as in Fig. 2.

So, the process involved in the proposed model is as follows in Fig. 3:

Input Video Stream The proposed system takes input from captured images and recorded videos of CCTV cameras. The cameras are placed in fixed angle and video frame's view changes to 2D bird's view in order to get the accurate estimation of the distance between each person. The view is taken such that the people within the frame are levelled on horizontal plane. Then, from this horizontal plane, four points are selected which help to change it into bird's view and after this the position of each person is calculated from this bird's view.

Object Detection The approach of object detection is used to reduce the computational complexity issues. It makes use of single regression model in order to detect the objects. The model for object detection is based on deep learning model which is best suited for real-time applications and provide faster and accurate results. In

```
                    Variable explorer  Help  Plots  Files

   Console 1/A

social_distance_API')
[INFO] loading YOLO from disk...
[INFO] accessing video stream...
######
[[(234, 222), (290, 282)], [(196, 228), (240, 279)], [(231, 224), (288, 283)],
[(188, 231), (235, 278)], [(228, 228), (286, 287)], [(194, 232), (233, 283)], [(229,
228), (284, 286)], [(201, 231), (238, 283)], [(232, 229), (287, 287)], [(187, 240),
(235, 286)], [(232, 228), (287, 286)], [(58, 199), (104, 257)], [(189, 240), (235,
285)], [(155, 238), (195, 288)], [(39, 238), (61, 283)], [(0, 232), (31, 297)],
[(109, 194), (160, 281)], [(149, 227), (202, 287)], [(115, 231), (154, 284)], [(5,
173), (74, 265)], [(75, 231), (112, 283)], [(0, 190), (11, 265)], [(11, 184), (70,
255)], [(105, 232), (151, 283)], [(76, 230), (93, 261)], [(0, 195), (13, 247)],
[(150, 227), (206, 286)], [(111, 231), (154, 282)], [(150, 227), (205, 287)], [(113,
231), (154, 282)]]
#####
[[(4, 221), (203, 450)], [(50, 197), (108, 265)], [(0, 222), (37, 312)], [(102,
195), (159, 276)], [(107, 241), (200, 360)], [(385, 284), (523, 368)], [(4, 221),
(202, 446)], [(49, 200), (107, 264)], [(1, 222), (37, 314)], [(102, 197), (165,
297)], [(380, 286), (523, 367)], [(92, 188), (157, 304)], [(7, 225), (164, 447)],
[(51, 203), (102, 257)], [(111, 239), (191, 366)], [(0, 232), (31, 302)], [(96,
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(192, 362)], [(379, 286), (526, 377)], [(1, 232), (33, 302)], [(51, 201), (100,
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[(0, 230), (31, 303)], [(108, 244), (195, 361)], [(5, 212), (163, 443)], [(382,
287), (524, 374)], [(6, 233), (102, 447)], [(307, 289), (441, 369)], [(491, 282),
(599, 452)], [(2, 241), (101, 440)], [(150, 228), (208, 294)], [(406, 32), (597,
459)], [(306, 289), (441, 368)], [(5, 233), (100, 442)], [(30, 195), (86, 268)],
[(304, 290), (441, 369)], [(434, 21), (603, 478)], [(6, 240), (100, 438)], [(19,
190), (91, 286)], [(306, 287), (442, 368)], [(432, 34), (603, 466)], [(160, 227),
(213, 299)], [(4, 239), (101, 433)], [(111, 227), (157, 285)], [(3, 180), (81,
281)], [(305, 290), (443, 370)], [(439, 23), (600, 480)]]

[ WARN:1] global C:\Users\appveyor\AppData\Local\Temp\1\pip-req-build-
kh7iq4w7\opencv\modules\videoio\src\cap_msmf.cpp (434) `anonymous-
namespace'::SourceReaderCB::~SourceReaderCB terminating async callback

In [2]:
```

Fig. 2 Showing the coordinates of a person

Fig. 3 Process involved in
proposed model

Input video stream

Object detection

Distance measurement

Depict output result
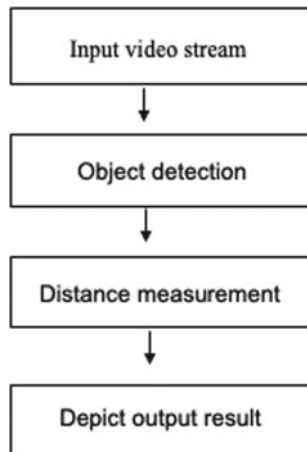
our approach we detect the people by using YOLOv3 model which take image or video as input and can learn and draw bounding box coordinated simultaneously along with corresponding class label probabilities and object confidence. YOLOv3 is a trained model for common objects in context.

Distance Measurement Distance measurement is used for calculating the intervals between set of individuals from bounding box for each mapped person. The proposed work is performed by mapping the bottom center of box to each person within the range is considered.

Depict Output Result The input video which is at an angle and hence the perspective of recorded video is changed into two-dimensional bird's view frame by frame in order to get the precise calculation of pair wise distances between all detected people in a frame. The video view is changed and each person within the range of view of camera is detected. All detected person within the frame is represented using points and circles. Also, the persons with distance lower than acceptable minimum threshold value are depicted using red points whereas persons with distance more than threshold are depicted by green points.

4 Proposed System Architecture

The proposed approach monitors the position of each and every individual of the specified location on real time and by maintaining the threshold value helps in ensuring the safe social distance among individual at public places. This section defines the proposed architecture and the functioning of the proposed system in order to maintain the social distance among individual and thus preventing the spread of corona virus. The proposed system uses computer vision technology for detecting and monitoring people within a public place by using cameras whereas uses transfer learning approach for optimizing performance with deep learning algorithm.

YOLOv3 algorithm is used for detecting over 3000 classes in order to achieve the desired results. COCO dataset is used in this approach along with a single person class for required results. Once the person class has been detected and tracked, a new ID has been assigned to each detected person and box is made along all such detected person and centroid of the box is measured thereof in Fig. 4.

5 Result

The proposed approach takes pre-filmed video of crowded area as input for the approach. The input video is taken at an angle and the recorded video is then changed to two-dimensional bird's view frame by frame in order to get the precise calculation of pairwise distance among all people detected within a frame. The video view is
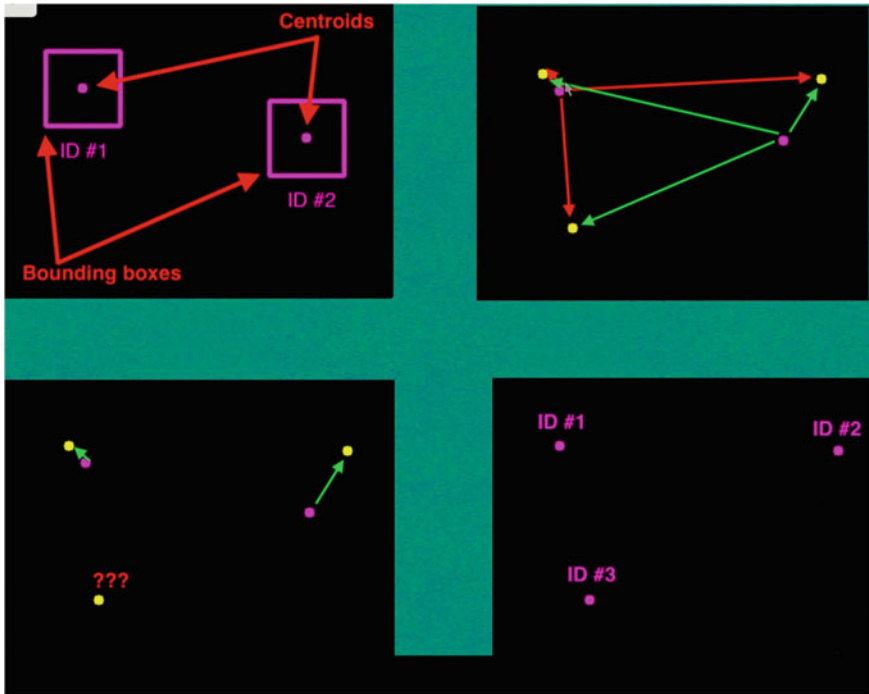
Fig. 4 Architecture of proposed Model

changed and each person within the given range of camera's view is detected. The person detected within a frame is represented using points and circles whereas the detected person having distance more than minimum threshold is depicted using green box as shown in Fig. 5. Any people having distance less than acceptable minimum threshold is depicted by red box as shown in Fig. 6. Any overlapping frame may cause error which is eliminated by adding quadrilateral box.

In the above approach the number of people violating the social distance norms is also calculated and number is shown. The proposed approach also added with voice enabled announcement system where the announcement is done using text to voice conversion which will help to hear the persons violating the social distancing norms.

6 Conclusion

In the proposed approach, we had used YOLOv3 algorithm for calculating the social distancing among people and mark them using green and red boxes. The proposed approach is further extended using text to voice conversion technique which will enable to get voice-based alert for violation of social distance norms. The proposed

Fig. 5 Illustration of social distancing above threshold value

Fig. 6 Illustration of social distancing below threshold value

approach was developed based on COVID guidelines and further extended to be used in malls, parking lots etc. in order to ensure the security. The error appeared in the proposed approach is eliminated using different approach.

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Key Based Steganography Using Convolutions

Saksham Arora, Pranav Gupta, Vishal Goar, Manoj Kuri, Harpreet Kaur Channi, and Chiranji Lal Chowdhary

Abstract In information security, one of the most predominant tasks is to safeguard crucial information from potential intruders. This information is supposed to be safe in password-guided vaults or secure cloud storage. However, with increasing cyberattacks, additional security layers to this vulnerable sector are never redundant. Focusing on image data, a confidential image can be embedded in some other random image to hide the asset but many naïve approaches to achieve this has been broken down. The approach presented in this report is focused to increase the complexity of the architecture of the existing models. The proposed model encrypts the confidential image with a key and hides it in another random image in such a way that is safe to send. With this, even if the manipulation is somehow identified, the processed image is expected to be robust enough to withstand reverse engineering methods. The model thus ensures utmost confidentiality. The retention rate is calculated in terms of SSIM value as 0.828. The average PSNR value is 70.495. The mean square error was 0.017. The reconstructed, noisy images can also be digitally premastered to refine the quality.

Keywords Computer vision · Convolutions · Deep learning · Steganography

1 Introduction

The technique used for hiding secret data within a public file or message to avoid detection is known as Steganography. Steganalysis is the process of revealing the message that was concealed via steganography. It acts as a more effective means

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of communication security than encryption, which merely conceals the message's content and not its existence. Image, text, audio/video, and protocol are the four primary categories of steganography, and Shih [1] and Morkel et al. [2] have provided excellent explanations of each. However, the focus of this report is on image steganography and a strategy to guarantee the highest level of confidentiality.

The clumsy approach to utilising steganography with convolutional layers is to employ two networks, with the first network learning to build a container picture by concealing the secret image inside the cover. In order to recreate the original hidden picture or exposed image, the second network uses the container image as input.

The task here is to increase the complexity of steganalysis. This is achieved with distorting the image first using a key, before hiding it inside another image. This is done so if an intruder recovers the secret image, they will receive a distorted image. The process of un-distorting this image can only be done by using the key which was used to distort the original image, otherwise, a brute forced/hit-and-trial approach has to be applied and this brute force approach would take physical attention (or a trained AI model which scans for image patterns) after every possible hit which is practically not possible, hence assuring the security. The dataset used is the ImageNet Dataset maintained by Stanford University [3].

The significant contributions under this work can be summarized as follows:

- Added pre-steganography and post-steganalysis processing layers to ensure confidentiality.
- Suggested architectural changes in the existing steganographic models.
- Introduced new ways to the field resulting in multiple opportunities for future work and research.
- Provided National Security Infrastructures with more secure and static options to store and transfer data.

2   Materials and Methods

2.1   *Convolutional Neural Network (CNN)*

CNN's are a type of artificial neural network that are most frequently used to evaluate visual data. It contains of convolutions filters, which are used to highlight the features in an image; pooling layers, which select a small set of pixel values from the pixel set to reduce the data size while still keeping the important attributes selected by the convolutional layers; and dense layers which are actual neurons which learns the highlighted patterns. In the proposed approach, only convolutional layers are used [4–6]. The secret image is passed through several convolutional layers, appended in the cover image and passed from convolutions - several times again. Every epoch results in a smaller loss and a final image that looks like the container image with the hidden image inserted beneath.
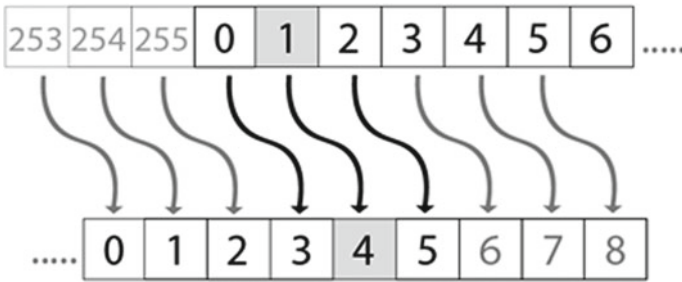
Fig. 1 Mechanism of applied Caesar's cipher in an RGB channel with key $= 3$

2.2 Random Module of Python

Choose a possible permutation of the given array which mimics a shuffling effect. This module can be provided with a seed, which selects the same particular permutation every time, among all the possible permutations of a given array. If seed is not set by the user, the module sets the seed based on the timestamp of the function call.

2.3 Caesar's Cipher

One of the earliest and most basic encryption techniques is the Caesar Cipher. It is merely a sort of substitution cypher in which each letter of a given text is substituted with a letter from a certain number of positions farther down the alphabet. With a shift of 1, for instance, A would become B, B would become C, and so on. Julius Caesar, who reportedly employed it to communicate with his officials, is said to be the inspiration for the method's name. An example of this, with Key $= 3$ is given in Fig. 1.

For an image, Caesar's cipher encodes every pixel numeral by adding a given key to change its value. If the encoded numeral exceeds the maximum unsigned byte value, it reduces the value by $255 + 1$ ($+1$ because of 0-indexing) as in Eq. (1)

$$\text{Caesar Cipher}(x) = \begin{cases} x + \text{key}, x \leq 255 \\ x - (255 + 1), \text{otherwise} \end{cases} \quad (1)$$

2.4 Activation Function

The rectifier or ReLU activation function is an activation function defined as the positive component of its argument, making the negative activated output values 0.

$$\text{ReLU}(x) = \begin{cases} 0, x < 0 \\ x, x \geq 0 \end{cases} \tag{2}$$

After passing through a filter, a number can become negative. However, a pixel value in an image cannot be negative. To address this issue, the filters are activated with the ReLU activation function. So, the negative part (and therefore theoretically insignificant) can be turned 0 which is an acceptable value.

2.5 Peak Signal to Noise Ratio (PSNR)

It is used in artificial neural networks. The maximum strength of a signal divided by the power of corrupting noise that degrades the accuracy of its representation is known as the PSNR. It is represented by:

$$\text{PSNR} = 20 \cdot \log_{10} \frac{\text{MAX}_I}{\sqrt{\text{MSE}}} \tag{3}$$

2.6 Adam Optimizer

An algorithm for gradient descent optimization is called adaptive moment estimation. When dealing with complex problems involving a lot of data or factors, the strategy is incredibly effective. It is effective and uses little memory. It is essentially a combination of the Root Mean Square Propagation (RMSP) algorithm and the gradient descent with momentum technique. In Fig. 2, the performance is significantly better than many of its competitors [7]:

2.7 Loss Functions

Baluja [8] showed the reveal loss and complete loss in a network performing steganography:

$$\text{Reveal Loss} = \beta \cdot \left| S - S' \right| \tag{4}$$

$$\text{Full Loss} = \left| C - C' \right| + \beta \cdot \left| S - S' \right| \tag{5}$$

C and S are the cover and secret images respectively, and β is how to weigh their reconstruction errors.
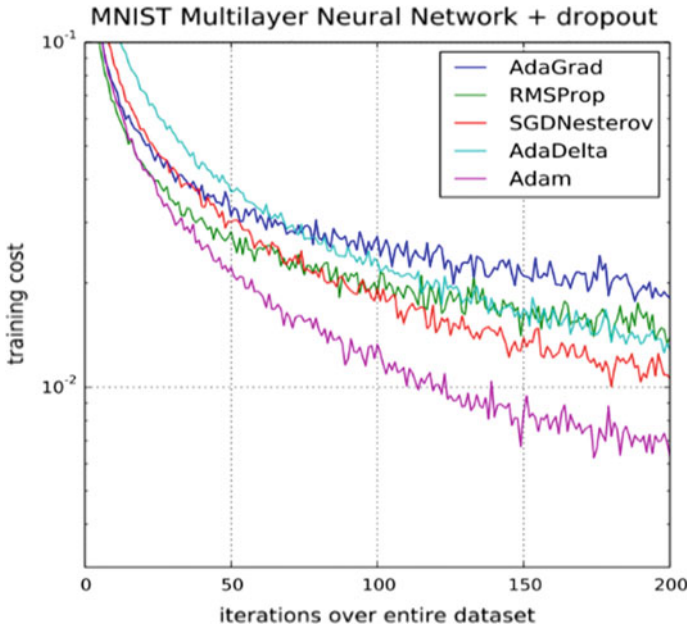
Fig. 2 Performance comparison of different optimizers on training cost

3 Proposed Architecture

Figure 3 covers the noteworthy parts of the architecture which shuffle and de-shuffle algorithms of Caesar's cipher and Convolution networks. The shuffling algorithms and Caesar's cipher distort and restore the image. The convolution network learns how to embed image. More pixels can be concealed there when the network determines which areas are redundant over time. Caesar's cipher can be added depending on the use case.

(1) A secret image is distorted using a key/seed based shuffling cipher (or additionally with Caesar's cipher).
(2) It is then embedded in the cover image to produce a container image.
(3) This container image, when undergoes the revealing network, reveals the distorted image with some loss.
(4) This distorted image can be restored back with the help of the key/seed used.

4 Results

In this section, experiment results are shown. The algorithms are executed to evaluate the performance of proposed technique using tensorflow.keras on Google Colab.
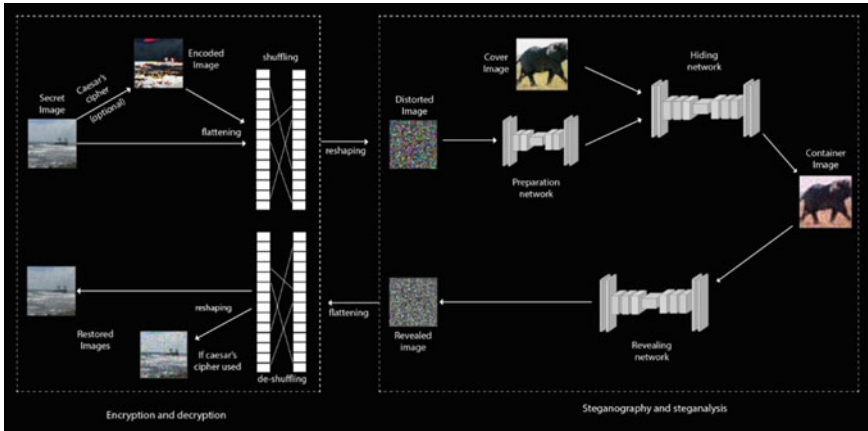
Fig. 3 Architecture diagram of the proposed system

4.1 Comparison Between the Results with and Without Caesar's Cipher

The code takes around 14 min to run completely on the Google Colab standard GPU. The loss reduction over 60 iterations is shown below in Fig. 4:

We can see that the loss isn't saturated yet, and hence the loss can be lowered down even more and therefore, more iteration can be added. However, this will also lead to more time consumption.

Figure 5 shows the distribution of errors in the cover and secret image without and with applying Caesar's cipher to the proposed model.

The measure of Structured Similarity (SSIM) a comparison statistic called SSIM is employed to determine how similar the cover image and the stego-image are.
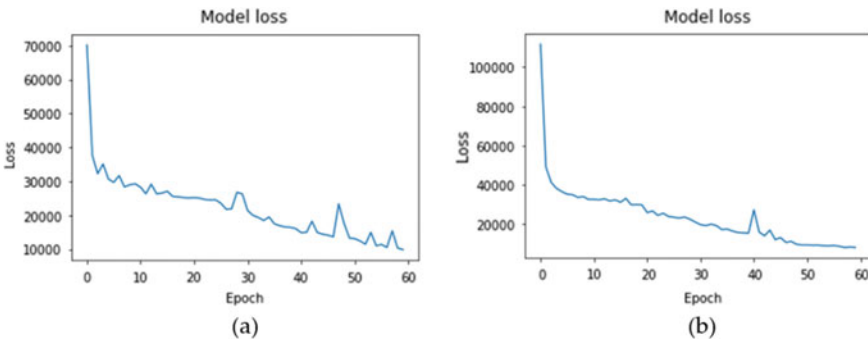
Fig. 4 Full model loss **a** without and **b** with Caesar's cipher
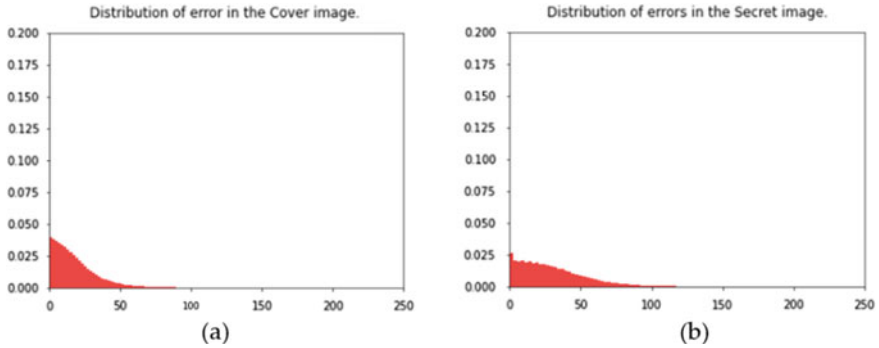
Fig. 5 Distribution of errors in **a** cover and **b** secret image without applying Caesar's cipher

Table 1 SSIM, PSNR and MSE values without and with Caesar's cipher

	SSIM	PSNR	MSE
Without Caesar's cipher	0.828668	70.495759	0.017403
With Caesar's cipher	0.647042	69.584507	0.021465

Measured is the apparent difference between the two photographs. Python was used to import the Skimage metrics (Table 1).

4.2 Comparison with Other Works

The findings of the suggested methodology are compared with the models of image steganography that have already been created using various other ways in this section through Table 2.

The work results are shown in Fig. 6, whereas the results of the suggested model, both with and without Caesar's cypher, are shown in Figs. 7 and 8. Do notice what the Intruder's view would be when they'd try to capture the image back.

Table 2 Comparison with similar works

J	Ref [9]	Ref [10]	Proposed Work	
			Without Caesar's cipher	With Caesar's cipher
Dataset	ImageNet	ImageNet	ImageNet	ImageNet
Method used	CNN	GAN	Convolutions	Convolutions
Architecture	General architecture	U NET	General architecture with randomization	Encryption with Caesar's cipher and randomization
MSE	0.00829	0.00043	0.01774	0.02146
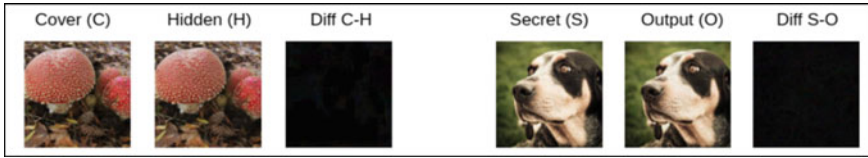
Fig. 6 Visual representation of results

Fig. 7 Visual representation of results of the proposed model without Caesar's cipher
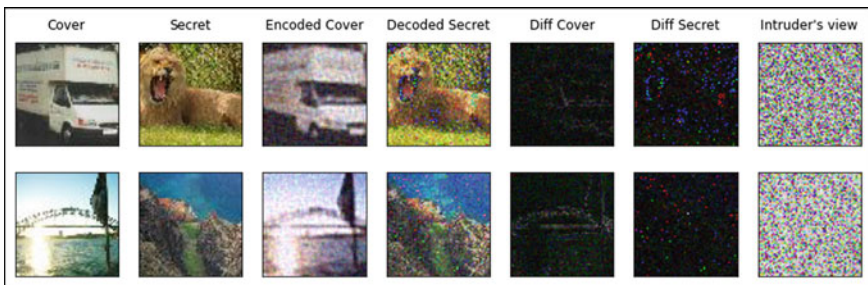
Fig. 8 Visual representation of the results of the proposed model with Caesar's cipher

5 Discussion

This report proposed a new ideology to deal with man-in-the-middle attacks by using encodings and image steganography. Standard methods achieve a high degree of accuracy but the changes can be spotted by a specially trained network and the original image can be somehow retrieved.

With the proposed model, if an intruder tries to crack open the embedded image with their specially trained network, it would not be possible for them to capture the original secret image. They'll receive a distorted image and will be in no position to restore the original image without the seed/shuffle key which was used to distort the image. In addition to this, the incorporation of Caesar's cipher was also discussed which guarantees an unreal theoretical confidentiality but results in more noise in the restored image.

The main reason behind the resultant score of the model is shuffling after flattening of the complete image. Due to this, a 3D array gets dissolved as a 1D array and many drastic changes are exposed to the image. When the image undergoes hiding and

revealing, the small losses turn exponential and the restored image is observed with a huge amount of noise.

6   Conclusion

No other system ensures a complete confidentiality rate, (as compared with [9] and so, it can be said that this research will act as a gateway to new possibilities in this domain. Also, sometimes, for example in terms of national security, the quality of the image can be compromised but the confidentiality is to be 100% assured. In those scenarios, this model can be a significant actor. Moreover, the noise can be reduced after successful decryption on the receiver's side by remastering with appropriate methods to obtain a clear image.

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